

CITY OF CHICAGO

RESILIENT REVITALIZATION

PHASE 2 DRAFT APPLICATION

NATIONAL DISASTER RESILIENCE COMPETITION

FOR PUBLIC COMMENT

October 9, 2015

EXHIBIT A: EXECUTIVE SUMMARY

BACKGROUND: Chicago is the third largest City in the country with a population of 2.7 million situated in the heart of the Midwest industrial and agricultural base, straddling the divide between the Great Lakes and the Mississippi watersheds. The city and region is a former wetland that is now highly impervious. Chicago's economy is one of the world's largest and most diversified, with more than 4 million employees generating an annual gross regional product of over \$500 billion, and leading industries from manufacturing to information technology to health services. Chicago is a global transportation hub, home to two of the nation's busiest airports and the nation's second busiest transit system, and handling 25% of the country's freight shipped by rail. The City is rich in culture, and its diverse population is 45% white, 33% Black/African American, 5% Asian and 17% other races with a 29% Latino or Hispanic population distributed throughout. About 29% of the total population is categorized as below the poverty level.

The Emanuel Administration has invested in making Chicago a City that withstands, responds and adapts to challenges more readily and creates better outcomes for everyone. Through one of the Administration's key strategies, "Chicago Neighborhoods Now," the City is coordinating planning and capital investments to ensure every neighborhood is equipped with access to jobs, public transportation, quality education, safe streets, parks, libraries, broadband and grocery stores. Already, high school and community college graduation rates are increasing, unemployment has fallen by more than a third, and 73,000 new jobs have been created since 2011. This progress underscores our need to build resiliency so that these gains can be realized in every community.

THE DISASTER: On April 17 and 18, 2013, severe storms produced approximately 5.5 inches of rain in Chicago during a 24-hour period, about the amount that typically falls over a two

month stretch. The excessive rainfall could not flow fast enough through the City's sewer system to a wastewater treatment plant or a combined sewer outfall. As sewer water rose above drain openings, water backed up into homes, businesses and other buildings causing extensive flooding throughout the City. Albany Park on the City's north side experienced riverine flooding when the North Branch of the Chicago River overtopped its banks, causing damage to 70 buildings. The City received 2,500 "water in basement" calls and over 800 "water in street" calls from residents in its 50 wards. Chicago Transit Authority (CTA) received calls about flooding at stations and viaduct locations. Some business experienced flooding that affected inventory and others had to temporarily shut down. On April 18, Governor Pat Quinn declared Cook County and 37 other counties State Disaster Areas. On May 10, FEMA issued a Presidential Disaster Area declaration. The City worked closely with FEMA and HUD to assess unmet recovery needs and to secure and direct disaster recovery funds to Chicago's most impacted and distressed communities, including \$63 million in CDBG-DR funds approved by HUD in 2014 and 2015.

THE PROPOSAL: Climate Change projections show that in the coming years Chicago can expect two to three times the number of heavy precipitation events and two to six times the number of 100 degree days. The city has had four "ten year storms" in the past six years. Chicago may experience average temperatures 4.4-4.7 degrees warmer and an additional 5-10 days over 95 degrees by mid-century. Chicago is committed to working locally, regionally and nationally to demonstrate preparedness and resilience and is starting from a strong foundation with Climate, Infrastructure, Community Investment and Health plans and policies in place.

The City has remaining unmet recovery and resiliency needs to address housing, infrastructure and economic revitalization in impacted and distressed areas. The City has formed a Chicago Resiliency Team (CRT) across Departments and agencies that analyzed impacted and

distressed communities to identify a target demonstration area for resilience projects. Based on FEMA assistance data and economic hardship data, the CRT identified a demonstration area comprised of six West Side communities, Austin, Humboldt Park, East Garfield, West Garfield, North Lawndale and South Lawndale, referred to as the West Side Demonstration Area (WSDA).

The WSDA, which comprises 22.5 acres, is home to approximately 300,000 residents, 88% of the census blocks are low-to-moderate income and the local employment rate is almost three times the city average. Geographically the WSDA is a microcosm of Chicago's landscape with largely flat land divided into three land use types, types which are repeated throughout the city – Neighborhoods, Industrial and Commercial Corridors, and Regional Parks and Boulevards. The WSDA serves as a template for approaches that could be deployed throughout across Chicago.

In one-on-one meetings, 10 community engagement sessions and 2 public hearings during 2015 the CRT engaged residents, community organizations and small business owners in the WSDA to better understand impacts from the April 2013 storms and ongoing community challenges and to elicit community ideas about resiliency needs and opportunities.

With this ongoing engagement and input, the CRT and partners have developed a Resiliency Revitalization Program (the Program) to deliver a resilient revitalization in the WSDA – this Program can serve as a model for all of Chicago and for urban flooding nationally. The Program leverages a combination of targeted data, policy, programs, and infrastructure to deliver highly concentrated green infrastructure and related programming, policy and innovative measurement. This will transform the three land use types, capturing stormwater, creating new gathering places, reducing urban heat island, and creating economic opportunity in their construction and maintenance. The Program directly builds resilience capacity in neighborhoods through the

creation of a Community Resilience Council (CRC) anchored in eight (8) existing neighborhood organizations who are committed partners in this application as well through seven (7) local housing and manufacturing support organizations who are also committed. The City has direct experience over many years in delivering green infrastructure and in working with the partners.

The Program, which has a cost benefit ratio of approximately 2 has been modeled to reduce stormwater run-off by 25% in the impacted areas through a focused application of eight (8) types of green infrastructure that are applied across ten types of land. The Program also delivers local jobs, new and improved gathering places in schools and parks and better connectivity through safer streets and transit access. Ultimately the Program will transform 405 acres of park land, 22 school campuses, 70 blocks of commercial streets, and 7,650 homes. The full budget for the program is \$435,853,731. City has identified over \$235 million in funds for direct financial commitments to this Program with an additional \$250 million in supporting commitments.

The Program is built through the internal city CRT, which is led by a new Executive Committee, and the external CRC. Infrastructure work will be delivered through a five (5) step process anchoring in initial ongoing modeling for impact. Community work will leverage neighborhood organizations and the housing organizations that are currently delivering the 2015 allocation of CDBG-DR dollars from the April 2013 flood. Overall measurement will build on the four core aspects of Resiliency Value, Environmental Value, Social Value and Economic Revitalization and then go much deeper. In partnership with Argonne National Laboratory, UI Labs and the University of Chicago, the Program will deploy an integrated network of in-ground and above-ground sensors that will deliver detailed data on performance from a local environment perspective.

There are several core aspects that anchor the transformative aspects of the Program. This will be the first time green infrastructure, which the City has experience building and managing, will be highly geographically concentrated in neighborhoods and within sewersheds leading to profound stormwater impact as well as broader infrastructure changes to crucial neighborhood assets (schools, parks, local commercial streets, etc). Ongoing decision making is supported by a detailed existing sewer model. Local neighborhood groups, which currently address the pressing needs of their communities, are committing to embed resilience in their work. The City departments and agencies are establishing an ongoing focus on cross-disciplinary resilience work to deliver the integrated elements of the Program. Selected features in the green infrastructure will be delivered by Greencorps, a 20 year old city of Chicago workforce program that serves adults who have barriers to employment, many of whom live in the WSDA. Measurement will leverage both social science research as well as cutting edge in-ground and above-ground sensors to validate in the impact of the physical changes. Chicago will leverage its role as a founding member of the Northeastern Illinois Resilience Partnership (the Partnership), to coordinate its efforts regionally to improve the health and vitality of Northeastern Illinois in response to the severe, repetitive, and chronic effects of flooding. Additionally, through participating in the Rockefeller Foundation's 100 Resilient Cities Program, Chicago will share results from its programs and projects with cities across the country and the globe. These approaches and platforms will deliver a transformation to the WSDA and serve as a replicable backbone to future work.

EXHIBIT B: THRESHOLD REQUIREMENTS

B.a. Eligible Applicant. The City of Chicago was identified by HUD as eligible for the NDRC and was invited to participate in Phase 2 (See U.S. Department of Housing and Urban Development June 22, 2015 letter from HUD Deputy Assistant Secretary for Grant Programs).

B.b. Eligible County. In April 2013 both the City of Chicago and Cook County experienced storms and flooding (2013 Storms) for which a major disaster declaration FEMA-4116-DR-IL was made.

B.c. Most Impacted and Distressed Target Area. The 2013 Storms caused damage to houses, infrastructure and businesses throughout the City. HUD declared Cook County (including Chicago) to be most impacted (www.huduser.org/cdbgrdr/appendixa). The City has recovery and resiliency needs from the 2013 Storms that have not been addressed by Federal, State, or other sources as described in Exhibit D.a.2. Demonstrating Unmet Recovery Needs Threshold Requirement.

In order to meet the goals of the National Disaster Resilience Competition (NDRC) the City created a Resilience Prioritization Mapset by overlaying heat maps showing (1) Economic Hardship Index Score and (2) Concentrations of 2013 Storm FEMA individual and household assistance recipients (Attachment E). The City drew boundaries over three areas that showed the nexus of damage and distress with high levels of economic hardship and concentrations of FEMA assistance, and aligned with community boundaries and planning study areas. The City also reviewed hydraulic modeling and sewer capacity information for these areas. Based on this data, the City selected one of these vulnerable areas, the West Side Demonstration Area (WSDA), as its target area for NDRC planning and project work because it showed the highest concentration of economic hardship and a substantial number of FEMA-assisted households. The

WSDA includes the 94 census tracts that make up Austin, Humboldt Park, East Garfield Park, West Garfield Park, North Lawndale, and South Lawndale. The area contains the three primary land use types in the City – making it an ideal location to model and test resilience initiatives that can be scaled and replicated elsewhere.

The City’s NDRC strategies described in this application are designed to build from and leverage existing CDBG-DR investments, coordinate additional resources, and create model community resilience strategies in the WSDA.

B.d. Eligible Activity. Resilience measures in the WSDA have been developed with community input. Working with the community and with experts, the City developed a portfolio of interventions that can be applied in different neighborhoods in the WSDA in order to meet unmet recovery needs, reduce flooding risk during future storms and make the area more resilient to other potential climate change impacts. The planned interventions include investment to dramatically increase stormwater capacity, the creation of new green space for stormwater retention and detention as well as public use and recreation, investment in green infrastructure within the public right of way, and the development of sustainable urban infrastructure policies and guidelines. The City will also employ land use mapping, and the collection and measurement of impacts to climate and social factors. These projects have been developed to meet HUD criteria and tie back directly to the flooding experienced in 2013.

The City of Chicago Department of Planning and Development (DPD) and The Chicago Metropolitan Agency for Planning (CMAP) have begun discussions about incorporating green storm water infrastructure into land use plans. With the Pilsen-Little Village land use strategy we plan to incorporate the WSDA Little Village project area and make recommendations for the

remainder of the community. CMAP will support a planning effort in North Lawndale in 2016, and will be able to use this strategy within the rest of the region.

As far as green technology requirements, our investments will be in public spaces and not within buildings, so LEED or energy efficiency standards will not necessarily apply. The Chicago Department of Transportation has developed Sustainable Urban Infrastructure Policies and Guidelines which, similar to LEED, set a series of environmental categories, objectives and requirements for CDOT projects in the public right of way. The requirements in this document grow over time. The original set of policies from when the document was issued in 2013, increased in 2015 and are set to increase again in 2018. The Sustainable Urban Infrastructure Policies and Guidelines are designed to be a growing, scalable document that can be used as a tool to direct and help set future policy. It is also part of a series of three documents that fully formulate CDOT's goal to implement Livable Streets. The first companion document, Complete Streets Chicago, addresses mode share and mode hierarchy and CDOT is currently developing Streets for People: Placemaking Policies and Guidelines to ensure that Chicago's streets provide great public space. The Department has engaged citizens throughout the City in a discussion about placemaking in the City's streets, with strong participation from residents in the WSDA.

This approach is rooted in strong community engagement and inter-disciplinary partnerships, and a commitment to measuring benefits and co-benefits and sharing results regionally and nationally. The City has developed and modeled standards for how these communities can be more resilient under a changing climate and other stresses.

B.e. Resilience Incorporated. The City has proposed a framework for building resilience that bridges infrastructure, environment, and socio-economic gaps that will be brought to life through a portfolio of projects that will build resilience and reduce flooding in the six-community

WSDA. The team has assembled a robust set of projects with multiple benefits to address Resilience, Social Benefits, Economic Revitalization, and Environmental Benefits. This project will build resilience by reducing property damages from flooding in future storms. Social benefits include increased recreational benefits of new bike lanes, health and aesthetic values associated with newly created green space, decreased dependence on automobiles, and improved mobility. Economic revitalization will take place through temporary and permanent jobs created for the installation and maintenance of the green infrastructure. The projects have also been designed for environmental impact to include reduced energy usage and water savings, reductions in stormwater runoff, reduced nutrient pollution, improved air quality, and to mitigate the urban heat island effect.

B.f. Meet a National Objective. All projects and activities outlined in this proposal meet the urgent need national objective in response to the 2013 flooding and mitigation of recurring floods within the WSDA. Projects to improve community resilience in the WSDA will directly benefit LMI residents and households. More than 88% of the census tracts in the WSDA are LMI areas and the City will ensure that more than 50% of funds are spent in these areas. Additionally, some projects will activate vacant land and buildings, which will prevent and eliminate blight.

B.g. Overall Benefit. Investments in the WSDA will help alleviate and reduce flooding in communities where the financial need is greatest and will overwhelmingly benefit minority communities. Over half of Chicago's area is comprised of Census tracts of low- and moderate-income households (LMI households) where more than 50 percent of the residents are at less than 80 percent of median income. Blacks and Hispanics make up over 90% of the population in these areas and each of the six (6) communities has over 28% of households living below poverty; per capita income levels below \$15,957; and unemployment rates above 15%, nearly

three times the current national average. Projects to improve community resilience in the WSDA will directly benefit LMI residents and households. More than 88% of the census tracts in the WSDA are LMI areas.

B.h. Tie-Back. The City's proposed investments to reduce flooding risk and increase resilience directly tie back to the April 2013 Qualified Disaster since the funding will be spent in areas that experienced flooding from April 2013 Storms, and will address unmet disaster impacts as well as build resilience to future storms and other incidents. In the CDBG-DR Action Plan approved August 25, 2015 (Third Substantial Amendment published for public comment period ending October 22, 2015), the City has demonstrated the nexus between proposed investments and known flooding incidents using call data from the City's 311 system and the location of verified loss payments from FEMA's Individual and Household Assistance Program. City-wide, these included nearly 27,000 individual or household FEMA recipients who received nearly \$60 million in assistance. Over 6,300 households received \$5.2 million in assistance in the WSDA,

B.i. Benefit-Cost Analysis. The City has prepared a benefit-cost analysis that justifies a \$200 million HUD investment in stormwater management infrastructure to reduce flooding risks and mitigate urban heat island effects. At the same time, these investments build a broad set of resilience outcomes, including economic opportunity, health improvements and social cohesion.

(See Attachment F.)

B.j. CDBG-NDR Applicant Certifications. See Attachment C.

EXHIBIT C: CAPACITY

C.a. Past Experience. Chicago's nationally-recognized departments and sister agencies have significant experience managing large federal grants, executing large-scale projects, leading innovative policy and infrastructure changes, and coordinating with diverse stakeholders. This application was developed and written by the City's cross-departmental Chicago Resiliency Team (CRT), led by the Mayor's Office and including the City's Office of Budget Management (OBM), Department of Planning and Development (DPD), Department of Water Management (DWM), Chicago Department of Public Health (CDPH), Office of Emergency Management and Communications (OEMC), Department of Transportation (CDOT) and The Chicago Park District (CPD). Once hired through Rockefeller Foundation's 100 Resilient Cities Program (100 Resilient Cities), the City's Chief Resilience Officer will join this team. In recent years, The City of Chicago and its partners have managed resilient disaster recovery and other activities similar in scope, scale and complexity to the ones proposed. DPD, DWM, and CDOT all have experience designing and constructing multi-million dollar capital projects preceded by extensive community participation and partner coordination. The City is familiar and compliant with 2014 and 2015 HUD General Section requirements and advances HUD goals through projects that provide housing stability to vulnerable populations, increase the safety and sustainability of homes, and foster economic growth, improved health and resilience in its communities. For example, the City's proposal calls for 120 acres of Complete Streets including Boulevards and Neighborhood and Commercial Streets connecting the WSDA's major parks. CDOT has completed many comprehensive and sustainable projects, such as the Pilsen Sustainable Street. The first phase, completed in 2012, demonstrates a full range of sustainable design. This \$14 million project is diverting up to 80% of the typical annual average rainfall from the combined

sewer system through a combination of bioswales, rain gardens, permeable pavements, and stormwater features. In partnership with the MWRD, CDOT modeled and is monitoring the project to evaluate design effectiveness, ensure predicted performance, and guide maintenance practices. Examples of capacity and experience with projects of similar scope are outlined below.

C.a.1. General Administrative Capacity.

Project or program management and logistics. The City of Chicago has extensive experience in project and program management and logistics.

Procurement for professional services and construction: The City of Chicago contracts for over \$2 billion of goods and services annually. The City has a procurement process in place with pre-approved vendors, enabling projects to be launched quickly. For example, DPD engaged eight design firms to provide pro-bono work supporting this application.

Contract management: The City of Chicago has extensive experience in managing contracts related to the over \$2 billion of goods and services contracted annually.

Financial management: The Office of Budget and Management (OBM) manages funds and maintains financial records for Chicago's \$72.8 million CDBG and \$63 million CDBG-DR awards. The City's fiscal controls ensure that funds are spent in a manner that is allowable, allocable, and reasonable. Through OBM, the City managed \$1.3 billion in grant funding in 2014 and nearly \$1 billion in capital projects.

Accountability/QA-QC/monitoring/internal audit: The Chicago Department of Finance issues the comprehensive annual financial report (CAFR), stand-alone financial statements for the Enterprise Funds and the A-133 Federal Single Audit Report. Financial statements are audited by independent accountants and receive unqualified audit opinions. The City also receives an annual HUD audit to ensure funds are administered according to regulations. City departments

administering programs ensure that programmatic and fiscal monitoring processes and procedures are in place and have comprehensive, well-defined procedures.

Rapid program design and launch: CDOT and other City departments, have proven track records for securing, obligating and expending funds quickly. DCOT received a through the Transportation Infrastructure Finance and Innovation Act (TIFIA) as well as the Transportation Investments Generating Economic Recovery Act (TIGER), both of which have stringent requirements for the obligation and expenditure of funds. The Department of Water Management (DWM) has recent experience implementing major stormwater management initiatives as part of Mayor Emanuel's \$7 billion, 2012-2015 infrastructure program. DWM is rebuilding and enhancing the City's water infrastructure through a \$1.4 billion investment to replace 900 miles of water pipes, repair 750 miles of water lines, reconstruct 160,000 catch-basins, and modernize water filtration plants, saving about 170 billion gallons of water by 2020. In 2015 alone, the City will invest over \$250 million to replace 90 miles of water mains.

C.a.2. Technical capacity.

Risk, impacts and vulnerability assessment, including information in extreme weather events, climate variability/change: The City has experience evaluating and managing risk, vulnerability and impacts both for potential disasters and threats as well as for programs and projects. The City has incorporated projected changes in weather due to climate in overall programs, policy and infrastructure including a science based research effort in the creation of the Chicago Climate Action Plan and ongoing work in Sustainable Chicago 2015 which include both climate mitigation and preparedness. The City has a long-standing commitment to identifying and incorporating climate data into its work; it consulted with scientists who described overall climate change scenarios and local impacts, and then developed both preparedness and climate

impact reduction strategies for its *Chicago Climate Action Plan* (2008). CTA and the Federal Transit Administration also recently studied climate impacts on transportation infrastructure.

Partners Argonne National Laboratory, Illinois State Water Survey, and the Midwestern Regional Climate Center all have experience collecting and analyzing climate science to inform analysis of future conditions, risks, and outcomes.

Management of project design (architecture, landscape architecture, engineering): The Chicago Park District's Department of Planning and Construction assesses and designs a variety of park projects including new construction (both building and parkland) as well as facility rehabilitations. For larger more complex projects, CPD's Department of Planning and Construction will supplement its in-house team by engaging the services of outside architectural and engineering firms as deemed necessary.

Site, city and regional planning: The City regularly engages in planning activities. For example, in 2013 the Chicago Plan Commission (CPC) adopted the Chicago Sustainable Industries (CSI): A Business Plan for Manufacturing. Initiated by DPD with Economic Development Administration funding, CSI provides strategies and actions for small and medium-sized manufacturers; coordinates government agencies around shared goals; and provides a framework for infrastructure investment that broadens the foundation for public and private-sector success.

In 2012, CDOT, in partnership with DPD, DWM, CPS, ComEd, the BNS Railroad, MWRD, and the community, completed the Pilsen Sustainable Street project. The street, one of the greenest in the country, was carefully coordinated with community partners to create plazas and support walking, biking and economic development while balancing neighborhood needs. The Chicago Park District's Department of Planning and Construction conducts site

investigation and applies city-wide planning strategies to assess need and guide future developments and land management.

Numerous City departments including CDOT, DPD and the Mayor's Office participate in the long range, comprehensive planning processes, including with our partner, the Chicago Metropolitan Agency for Planning (CMAP).

Flood insurance and flood plain management: The Chicago Park District's Department of Risk Management evaluates flood risk annually to ensure that the agency insurance policy has the appropriate level of flood insurance and the proper risk prevention measures are in place.

Green (nature-based) infrastructure planning and implementation: The City's Chief Sustainability Officer coordinates the green activities of numerous City departments. This includes the Chicago Department of Transportation's Livable Streets Section which oversaw the planning, design and construction of the Pilsen Streetscape and the City's Green Alley Program. CDOT also developed Guidelines for Complete Streets/Sustainable Urban Infrastructure approved in 2013. Additionally, \$50 million in DWM funds are being used over five years to build green stormwater infrastructure projects that will divert water. These projects range from use of permeable pavement when restoring streets after water lines are replaced to innovative transportation projects like shared streets and neighborhood greenways. These projects calm traffic and increase pedestrian and bicyclist safety and comfort while also providing stormwater BMPs including treatments will be incorporated in the WSDA Residential/Commercial/Industrial Complete Streets.

Pre-development site preparation: The Department of Planning and Development (DPD) administers numerous business assistance and financial incentive programs on behalf of local companies. DPD aggregates and arranges the sale of City-owned properties and provides

financial incentives for redevelopment projects. Examples of this include the redevelopment of vacant commercial land at 63rd Street and Halsted Street in the Englewood Community Area into a retail project that includes Whole Foods as an anchor tenant. The City provided land and TIF assistance to the project.

Property disposition: DPD has recent experience managing the conversion of vacant lots into community assets through its Large Lots Program. In 2014, with assistance from CMAP's Sustainable Communities Initiative, DPD and residents created the Large Lots Program, selling nearly 300 city owned parcels to community members for \$1 each. Residents are responsible for maintenance of these lots. DPD, NeighborSpace and Heartland Alliance established a 2-acre urban farm in Humboldt Park as a hub to support other gardening and agricultural initiatives within the WSDA. The City has transferred 69 city-owned lots through its Large Lot program in the Austin neighborhood this year, and has conveyed property to many entities in the focus area, such as to the Lawndale Christian Development Center.

Leveraged/mixed financing: The City has leveraged CDFIs, State Revolving Loan Funds, Social Impact Bonds and public-private partnerships to fund innovative projects. The City worked to create and launch a local infrastructure bank, the Chicago Infrastructure Trust (CIT), that leverages public and private sector funds for local infrastructure projects.

Acquisition and disposition of real estate including voluntary and involuntary relocation of homes and businesses: One recent example of property acquisition and relocation includes the City's acquisition of property owned by Vienna Beef and assistance moving the company to other space as part of a major street improvement and realignment project at Elston Avenue at Damen and Fullerton Avenues.

Rehabilitation and reconstruction of housing, commercial, industrial and other structures: DPD has extensive experience with the Rehabilitation and reconstruction of housing, commercial, industrial and other structures

Redevelopment of property from procurement through occupancy or final use: The City acquired the Viceroy Hotel from a private owner to preserve it as affordable housing. The hotel was subsequently sold for \$1 to Heartland Housing which was also provided other City funds including TIF and Low Income Housing Tax Credits to help retain it as affordable housing.

Remediation of brownfields and contaminated sites and ecological restoration: Within the last year, the Chicago Department of Fleet and Facility Management completed remediation on three parcels adding 2 acres of green space within the City. In 2013, the City remediated 0.7 acres to create space for the Eden Place Nature Center for gardening and education. The Chicago Park District managed the design and construction of park land over historically industrial sites such as La Villita Park and various properties in the Calumet region.

Accessing operating and investment capital: The City of Chicago's operating budget is developed, reviewed and approved annually in a process involving every City department and the City Council.

Assessing technical feasibility and value engineering: As part of the process for securing a \$98 million TIFIA loan for the Chicago Riverwalk, CDOT engineers worked to assure the technical feasibility of the project, which included building underbridge connections over the Chicago River, and had to value engineer the project to stay within the project budget while still meeting the standards set by the City and USDOT.

Additional Technical Experience: In addition, supporting expectations of this program, the City has extensive experience with workforce training and job development. The City's Greencorps

Program, which trains adults with barriers to employment for jobs in the green infrastructure industry, will work with DPD on outreach in addition to implementing green infrastructure projects in the WSDA. Greencorps trained 124 people from 2012-2014, with 73% of individuals completing the program finding permanent employment, and 72% of those employed finding work in a green infrastructure related field.

C.a.2. Community engagement and inclusiveness

Regional collaboration: The City regularly engages with surrounding and neighboring counties, as well as the State of Illinois, on workforce, education, transportation and development projects. The City is partnering with CMAP, Chicago's regional planning agency for the seven counties, 284 municipalities, and 8.6 million residents of northeastern Illinois, on this application and other resilience projects.

Cross-disciplinary collaboration: CMAP is responsible for developing and updating the region's comprehensive plan (GO TO 2040) that guides land use, transportation, environmental, and governance decisions. CMAP has extensive experience connecting local implementation to regional change, as well as building broad-based coalitions to tackle issues that cut across transportation, social, housing, economic, and environmental sectors.

Community engagement and outreach, especially with vulnerable populations and their advocates: The City regularly conducts community outreach and engages constituents in infrastructure projects. The Chicago Housing Authority has several developments, both public housing and mix-income, in and around the WSDA and conducts outreach and education programs for their clientele.

Project coordination in partnership with other key implementing stakeholders: The City coordinated with the Trust for Public Land and the Chicago Park District in the planning, design,

construction and maintenance of the Bloomingdale Trail – a multi-use, elevated, 2.7 mile linear park on Chicago’s northwest side.

Consultation and stakeholder involvement during need determination, design, implementation, commissioning and evaluation phases of a project: Chicago and its partners have experience through the Community Organizations Active in Disaster of Northeast Illinois (COAD) Long Term Recovery Committee (LTRC) with financing programs supported by community engagement and leading to capacity building. The LTRC, created to address unmet needs from the 2013 flood, coordinates recovery efforts of that flood, including the provision of additional long term assistance to individuals who do not have adequate personal resources for basic needs as a result of the flood. The LTRC created a case management group to contact each of the Individual Assistance (IA) applicants in Cook County who fall within a vulnerable population and had unmet needs following the receipt of FEMA assistance. By October 2013, the LTRC served 757 clients in Chicago utilizing the Coordinated Assistance Network. By January 2015, the LTRC had closed all but approximately 100 case files. As of September 2015, the LTRC has guided the development of the case management components of Chicago’s CDBG-DR funded Residential Flood Assistance Program. The LTRCs case files and disaster recovery data are the basis for this \$10.3 million program that will provide direct assistance to the City’s most vulnerable residents with the greatest long-term impacts from the 2013 flood.

During Phase I of this application, the American Red Cross, a COAD member organization, led their AmeriCorps teams to canvass door-to-door distributing 3,750 flyers in English and Spanish to residents announcing the community resilience building meetings in their neighborhoods. The COAD remains one of the primary mechanisms for engagement with community members and partners on disaster preparedness matters.

CDOT has implemented over 280 green alleys incorporating permeable pavements, open bottom catch basins, high albedo surfaces, recycled materials and energy efficient lighting. To assure continued benefit from the Green Alley program, CDOT has coordinated efforts with the Department of Street and Sanitation to develop a regular maintenance schedule of the alleys.

Working productively with other organizations, including meeting management: The City has productive working relationships with community, regional and national partners and manages complex projects with these partners across disciplines. One example includes CDOT prepares the agenda and invites appropriate participants for monthly coordination meetings with the Illinois Department of Transportation (IDOT) and Federal Highway Administration.

C.b. Management Structure

C.b.1. Existing Management Structure. In the fall of 2014, the Chief Sustainability Officer (CSO) began convening weekly meetings of staff from DPD, DWM & OEMC to consider the NDRC opportunity. CDOT staff joined the weekly meetings for development of Phase II. The CRT has also convened meetings to brief and get direction from Mayor's Office deputies as well as sister agencies (CPD, CTA, CPS). The CRT will continue to be the core of the management structure throughout the period of the NDRC grant. An organizational chart is included in Attachment # and summarized below.

The WSDA Community Resilience Program will be led by the Chicago Resiliency Team (CRT) with support from community, civic, and academic partners. The program will provide concentrated green infrastructure in six community areas on the West Side. The CRT will be overseen by an Executive Committee that will provide long-term strategic direction, resolve inter-departmental differences, and finalize project decisions.

The CRT Working Committee will provide ongoing project oversight, and put forward capital allocation and site selection recommendations with input from the community and independent evaluator, and keep City Commissioners and the Executive Committee informed of issues. The core members will be Deputy Commissioners/Project Managers from key departments implementing the grant: OBM; CDOT; DPD; DWM; OEMC; DFSS; and the CSO. Most of this team is already in place and has been working together on the WSDA Resiliency program since Winter 2014-15. City, sister, and delegate agencies not involved in delivery through the entirety of the grant period will be brought in and out on an as needed basis, and will include CDPH; CPS; CHA; CPD; and CTA. An external evaluator will attend meetings of the Executive and the Working Committees.

The Working Committee's decisions will be informed by a Community Resilience Council (CRC) that will be created as part of the program to ensure community and partner input, to build local resilience capacity within existing organizations and to coordinate and engage communities and businesses on all aspects of the resiliency program in the WSDA. The Community Resilience Council will facilitate public meetings at least annually, where the CRT will respond to community input and engage in discussions on programs, projects and plans.

The CRC will include neighborhood delegate agencies from the six WSDA community teams and local government staff from various departments and agencies responsible for the infrastructure and metrics programs. Local foundations will be made aware of the CRC through one-on-one meetings and/or invitations to participate to engage them in the long-term efforts. The CRC will help deliver the package of interventions that residents and local commercial businesses can undertake in their own backyard and on their block to lessen flooding risks, as well as energy efficiency tips, building safety, water conservation, and other issues to ensure that

they are prepared for the changing environment, including climate change and its impacts on the urban heat island and flooding risk from weather events. The team structure will serve to build the capacity of WSDA community-based organizations in the resilience field. The CRC will advise on schedule and timing issues as they relate to activities in the community and be a place to share experiences and improve practices.

Simultaneously, GreenCorps Chicago, CDOT's green jobs training program for those with barriers to employment, will meet the demand for constructing green infrastructure. DPD will coordinate with GreenCorp managers on the tasks for the community teams and ensure that GreenCorps staff are integrated into the CRC. Neighborhood delegates on the CRC will include Garfield Park Community Council, the West Garfield Renaissance Corporation, Garfield Park Community Council, Lawndale Christian Health Center, Enlace, LVEJO, Austin-Austin Coming Together, and Humboldt Park Development Council. Specialized organizations that will participate include housing organizations that are all current delegates for CDBG-DR dollars from the 2013 flood: Catholic Charities of the Archdiocese of Chicago, Latin United Community Housing Assn (LUCHA), Neighborhood Housing Services of Chicago, Partners in Community Building, Inc., and the Center for Green Technology. Openlands will lead community outreach efforts for tree planting throughout the WSDA, working to ensure that residents and businesses become stewards of the urban forest. In addition, DPD has identified private industrially zoned parcels which have the potential for stormwater capture and could provide a buffer between land uses. DPD will coordinate with IMEC on developing and marketing a program for owners of large industrial properties who are willing to use portions of their properties for a 20-year period for stormwater capture. Conversations with industrial property owners would be undertaken by IMEC staff and include a range of programs for manufacturers.

Additionally, the CRT will convene a Metrics and Measurement team, engaging academic and evaluation partners to facilitate data collection and analysis in order to measure progress and impacts for WSDA resilience projects. Several proposed projects include state of the art measuring technology in partnership with Argonne National Labs, UI Labs, and the University of Chicago. As projects are implemented, the Metrics and measurement team will monitor, collect and report resilience measures to the CRT.

Work will flow from the Working Committee into two delivery streams, Infrastructure and Community, with both project delivery processes to be informed by the Metrics/Measurement collaborative and the CRC. The bulk of the infrastructure will be implemented by CDOT, CPD, DWM, and CPS. Like many similar projects, the process will include: capital allocation, site selection, design, consultant selection, community task force engagement, final engineering, construction.

The implementation process for Community initiatives will include extensive outreach to homeowners, businesses and manufacturers to encourage participation. While the CRT has worked with its application partners in the past and is confident that they will help deliver the WSDA program, the City will consider other existing delegate agencies if any of the partners listed above fail to perform.

The CRT is a member of the recently formed Northeastern Illinois Resilience Partnership (NIRP). NIRP's mission is to build a more resilient region through stronger coordination and broader collaboration across a diverse institutional network. Its key objectives are: (1) cross-jurisdictional coordination to achieve the goal of scaling up successful interventions to create impact in communities across the region and state; (2) a *Regional Resilience Framework for Action* based on collaboration to advance efforts on planning, capacity-building, and policy and

institutional changes. Members include local and state governments, regional planning organizations, non-profits, research institutions, and other stakeholders that play a role in building regional resilience across the 7-county metropolitan area. The partnership is committed to meeting quarterly for five years. It will evaluate progress and effectiveness annually to help members adapt their approaches based on results and forge a possible ongoing extension of the five-year commitment.

Moving forward, the CSO will convene meetings of an Executive Committee comprised of department commissioners, Mayor's Office deputies and sister agency executives to ensure coordination with departmental missions and priorities. The CSO will convene meetings of the CRT to review and ensure coordination between the three NDRC work streams. 1)

Infrastructure projects proposed will occur in the public-right-of-way, in parks and at schools and will be constructed by the property "owners." Simultaneously, sewer upgrades will be underway. The City's Public Coordination Office, managed by CDOT, already provides coordination for projects in the public right-of-way. Additional coordination will be required for the NDRC street projects and those at parks and schools and will be provided by the Mayor's Office. 2) Metrics and Monitoring will be coordinated by the DPH/OMEC which is already responsible for gathering and reporting on wide array of metrics. DWM will be responsible for working with the university and lab partners for the new physical data gathering techniques proposed. 3) The Community Resilience Council and the contracts associated with residential, business outreach and implementation will be managed by a DPD senior project manager that will be dedicated to this project. In addition, DPD will provide staff support to the CSO for NDRC related issues and by contracting and managing a consultant to assist in further refinements of the project areas during the first half of 2016.

Grant management will continue to reside within the Office of Budget and Management which is also responsible for establishing fund lines for departments and interagency fund transfers.

EXHIBIT D: NEED

D.a. Unmet Recovery Need and Target Geography On April 17 and 18, 2013, storms produced approximately 5.5 inches of rain during a 24-hour period, which is equivalent to almost two months of average monthly rainfall (<http://www.sws.uiuc.edu/atmos/statecli/climate-change/NE-IL-trends/rainfall.htm>). This caused extensive flooding damage to private homes, businesses and public infrastructure throughout the City and the surrounding region. The excessive rainfall that entered the City's sewer system could not flow fast enough to a wastewater treatment plant or a combined sewer outfall. By early morning April 18th, before the largest rainfall, the City's Tunnel and Reservoirs Plan tunnels (TARP tunnels or "deep tunnels") were filled, resulting in combined sewer overflows at 132 separate outfall locations and over 23.7 billion gallons of rainwater mixed with sewage discharged into local waterways. To prevent overland flooding, the MWRD and the Army Corps of Engineers opened the Chicago River controlling locks for nearly 23 hours, leading to a discharge of over 10.7 billion gallons into Lake Michigan. As sewer water rose above drain openings that were below street grade, water backed up into homes, businesses and other buildings throughout the City. The City received 2,500 "water in basement" calls from residents in 49 of its 50 wards. Over 43,000 individuals applied for FEMA assistance; over 25,000 received Individual Assistance.

As described in Chicago's Phase I submission, basement flooding was clustered in the city's most economically-vulnerable West and South Side neighborhoods, while Albany Park on the North Side experienced riverine flooding. The City took a data-driven, scientific approach to analyzing neighborhoods most impacted by flooding by overlaying maps of flood occurrences reported to the City's 311 system, FEMA verified loss and assistance data, and economic and social vulnerability data. In order to develop comprehensive neighborhood resilience strategies,

the City selected a target demonstration area on the West Side (WSDA) that demonstrates high economic vulnerability, high risk of flooding, and concentrated damage from the 2013 Storms. The City engaged the WSDA community to develop resilience strategies that address remaining needs from the 2013 storms and help reduce the risk of future flooding while building the community's economy.

The flooding of April 2013 was a crisis that is increasingly common; Chicago has experienced four "10 year" storms in the last six years. In order to determine NDRC projects for the WSDA, Chicago is taking a holistic approach to assess risk from flooding and other hazards and designing a program that comprehensively reduces these risks. This approach includes three primary components. (1) Regional collaboration through the Partnership provides a coordinated effort to collect data, engage residents and local businesses, implement demonstration projects, create new policies, and develop a region-wide plan for improving resiliency to flooding and other climate impacts. (2) Comprehensive planning to reduce flooding within Chicago through doubling the City's investment in water infrastructure to replace aging infrastructure and improve service to Chicagoans, including over \$250 million annually to expand and modernize our sewer network and a \$50 million commitment over five years to construct green stormwater infrastructure. These investments are targeted at the most flood-prone areas and are thoroughly analyzed using DWM's state-of-the-art hydraulic computer model to optimize project design and determine the most cost-effective projects. The City will continue to utilize this science-based tool and will incorporate climate change projections into project planning and engineering through our ongoing partnership with the University of Illinois, the Illinois State Climatologist, and National Oceanic and Atmospheric Administration. (3) Through participating in 100 Resilient Cities, Chicago hiring a Chief Resilience Officer to develop a citywide resilience

strategy to address risks to the environment, public health, the economy, and social systems. These efforts build on existing efforts, including the Chicago Climate Action Plan, Sustainable Chicago 2015, and Building a New Chicago.

In this NDRC proposal, Chicago will build on the above efforts and bring to scale, integrate, and measure in the WSDA a range of strategies and techniques that have been piloted in disparate communities throughout the City over the past 15 years. By integrating these and other strategies in the WSDA, the City can reduce flooding risk while also providing multiple benefits that boost economic development, enhance property values, strengthen social connections within neighborhoods, enhance public health, and improve environmental conditions through increasing the tree canopy and reducing urban heat island effects. The strategies developed for the WSDA will serve as a model for the rest of Chicago, for the region, and for communities nationally and globally facing similar challenges.

D.a.1. Demonstrating Most Impacted and Distressed Threshold: The Chicago Resiliency Team (CRT) selected the West Side Demonstration Area (WSDA) as the geographic target area to execute this NDRC proposal because it has both the highest concentration of economic hardship and a substantial number of FEMA-assisted households (see description of Resilience Prioritization Mapset from Phase I submission p. 6-7). The WSDA includes the 94 census tracts that make up the six (6) communities areas of Austin (Area 1), Humboldt Park (Area 2), East Garfield Park (Area 3), West Garfield Park (Area 4), North Lawndale (Area 5), and South Lawndale (Area 6). The City intends to carry out localized five (5) project suites (the Resiliency Revitalization Program) spanning the six (6) community areas that make up the WSDA, tailored to the specific land use types and specific need found in each community area.

As demonstrated in Chicago's Phase I submission, both the City of Chicago and the

WSDA were “most impacted” as a result of the April 2013 storms. These target areas fall within Cook County, which was determined by HUD to be most impacted (<http://www.HUDUSER.org/CDBGDR/AppendixA>). The April 2013 storms caused damage to well over 100 homes in the CRT’s target area. In fact, more than 43,000 individuals within Chicago applied for FEMA Individual Assistance with at least 26,783 households in Chicago receiving assistance from FEMA for verified loss on account of the storms. Of these, 6,320 households that received assistance from FEMA for verified loss are in the WSDA. The City obtained identified Individual Assistance data from FEMA during the Phase II application allowing the City to calculate actual verified loss and assistance figures for the WSDA and the proposed project areas. [In Chicago’s Phase I submission, it was reported that 22,472 owned units and 8,605 rented units (for a total of 31,077 households) received assistance from FEMA for verified loss, and only 2,900 households in the WSDA.]

Both the City of Chicago and the WSDA experienced a greater disaster impact and a more difficult recovery and revitalization because of their “distressed” characteristics. Over half of Chicago’s area is comprised of census tracts of low and moderate income (LMI) households. 52.98% of people in the City of Chicago are at less than 80 percent of area median income (Please reference CDBG low and moderate income summary data at www.HUDUSER.org/CDBGDR/AppendixD under the “Local Government Summaries by State”). As for the WSDA more granularly, 88 percent of its census tracts are LMI areas. Additionally, the unemployment rate for Chicago as a whole is 6.5 percent - 127 percent of the national average unemployment rate of 5.1 percent. The unemployment rate within the WSDA is 19.8 percent (CMAP), which is over three (3) times the national average unemployment rate. Of the 41,000 residential buildings within the WSDA, 6,320 households (15 percent) received

assistance from FEMA.

D.a.2. Demonstrating Unmet Recovery Needs Threshold Requirement The City has recovery and resiliency needs from the 2013 Storms that have not been addressed by Federal, State, or other sources. The City's NDRC strategies described in this application are designed to build from and leverage existing CDBG-DR investments, coordinate additional resources, and create model community resilience strategies in the WSDA. As explained in Chicago's Phase I submission p.8, the City of Chicago was awarded \$63 million in CDBG-DR funding to assist its most impacted and distressed neighborhoods. The City's CDBG-DR funds include: \$10 million committed to build an 18-foot tunnel in the Albany Park community to divert flood water, making that community more resilient to riverine flooding; \$29.3 million for sewer infrastructure projects primarily in impacted and distressed areas on the south side of the city; \$10.3 million for a single and multi-family housing assistance program (being developed in close coordination with HUD and FEMA) that will both address unmet needs and help qualifying residents with mitigation and resiliency measures to prevent future flooding; and an additional \$11 million distributed to the Albany Park Tunnel (\$5.6 million) and WPA streets on the Southside of Chicago (\$5.475 million).

Housing: As part of the \$10.3 million housing assistance program, the City's delegate agencies are currently reaching out to the approximately 850 individuals (100 open casefiles for vulnerable individuals and households with unmet needs + 757 individuals who had a casefile at any point in the process) to offer additional assistance to bring households to a resilient standard. However, even with CDBG-DR assistance, vulnerable communities like the WSDA will not be able to rebuild to a resilient standard. Projected resilient retrofit costs for the approximately 6,320 housing units who received FEMA Household Assistance in the WSDA, would range from

\$34.76 million to \$148.5 million (based on the City's CDBG-DR estimate that the range of costs to make a flood-prone home in Chicago resilient to flooding is \$5,500-23,500 – Phase 1 submission p.8-9), exceeding the budget for the citywide \$10.3 million CDBG-DR housing assistance program. This cost estimated has increased from Chicago's Phase 1 submission due to the additional households identified to have received assistance from FEMA within the WSDA. Citywide, these costs would range from \$147.3 million to \$629.4 million. Due to the high cost of retrofitting every individual household to a resilient standard, the CRT is proposing a green infrastructure program at the combined household, block, and community level to address the housing need more globally.

Infrastructure: Additionally, as described in Chicago's Phase 1 submission p. 10-11, flooding damage from the 2013 storms to CTA stations in and supporting WSDA neighborhoods along the CTA Blue Line was not repaired to a resilient standard, and will continue to keep commuters in this vulnerable area from reaching centers of employment during more frequent storms. CTA estimates that bringing flood resilience to the supporting system will cost \$28 million. CTA only has secured funding for the design phase of this project (\$3.5 million) and has not yet identified construction funds. CTA and its engineers have recommend addressing water mitigation comprehensively, as isolating improvements just to 600 linear feet in a 4.1-mile line would push the problem elsewhere. In order to decrease future flood damage to the transit line that runs through the WSDA, the CRT is proposing a green infrastructure program that identify highest-impact investments more globally, based on their potential to reduce water in the sewer system and parcels that were owned by public entities, which will have a direct flooding reduction impact on the area's infrastructure.

Economic Revitalization: The WSDA continues to have unmet economic revitalization

recovery needs due to the April 2013 storms. As described in Chicago's Phase 1 submission, during the NDRC community engagement process and public comment period, six businesses in the WSDA provided documentation of remaining repairs from the 2013 Storms, with half of the businesses citing residual damage to their foundation or walls and from sewage entering their business through a floor drain or toilet. No funding has been allocated to date to assist these businesses and many others like them. All six businesses continue to have flooding issues and experience additional damage during heavy rainfalls and even during snow melts, proving the need for projects that improve their resiliency. Since submission of its Phase I application, the CRT has expanded its outreach and been engaged in conversations with 1-2 additional businesses that have remaining unmet needs from the 2013 storms. In order to decrease future flood damage along the WSDA's commercial corridors, the CRT is proposing a green infrastructure program that identifies highest-impact investments more globally, based on their potential to reduce water in the sewer system and parcels that were owned by public entities, which will have a direct flooding reduction impact on the area's businesses.

D.a.3. Unmet Need in a Broader Geographic Perspective. While the unmet needs described above qualify the City of Chicago and the WSDA specifically for the CDBG-NDRC, aggregate losses from repetitive flooding in the broader region illustrate that Chicago is just one piece of a wider, shared problem and unmet need for regional resiliency solutions. Cook County, neighboring DuPage County, and the State of Illinois were all separately and independently identified by HUD as eligible for this CDBG-NDRC on account of the same disaster for which the City of Chicago qualified. Flooding stands as the primary hazard facing the region, accounting for 41% of disaster losses statewide and resulting in over \$195 million in FEMA NFIP payments to the region since 1978 (CNT. "The Prevalence and Cost of Urban Flooding."

May 2013). Further exacerbating the issue is the fact that the severity and frequency of flooding will only increase with climate change. Precipitation in the Midwest has increased 37% over the last 54 years, and the National Climate Assessment projects further increases in extreme rainfall events and flooding as well as heat wave intensity and frequency (2014 National Climate Assessment Report. www.globalchange.gov). Most Midwest Regional Climate Center and Illinois State Climatologist models project that annual precipitation will increase by as much as 20% by 2100, with a significant portion from more frequent heavy rainfalls. Heavy downpours are already occurring 35% more frequently since the 1980s, a particular challenge given that rainfall events of 2.5 inches or more in 24 hours already cause flooding in the region (Walsh, J. et al. 2014. Ch. 2: Our Changing Climate. Climate Change Impacts in the United States. Melillo, J.M. et al. Eds., U.S. Global Change Research Program, 19-67). Additionally, increases in very hot and extremely hot days are projected to increase heat wave intensity and frequency, leading to an increase of between 166 and 2,217 excess deaths per year from heat wave-related mortality in the City of Chicago by 2081 to 2100 (Peng, R.D. et al. 2011. Toward a Quantitative Estimate of Future Heat Wave Mortality under Global Climate Change. Environmental Health Perspectives, 119, 701-706).

D.b. Resilience Needs within Recovery Needs.

Vulnerable Populations and Other Factors that Impact Resiliency. Past events have shown that vulnerable populations such as lower income households, persons with disabilities, homeless persons, the elderly, and minorities frequently are less resilient following a disaster. Chicago's proposal for this resilience competition seeks solutions for flooding that can serve as models across the city and throughout the region, but the City is strategically focusing initial investments

under this proposal on the WSDA that are most vulnerable and characterized by the highest rates of poverty and the greatest economic hardship.

Within the six (6) community areas of the WSDA, with a population of approximately 308,605 people, 88% of its census tracts are LMI areas. Blacks and Hispanics make up over 90% of the population in these areas and each of the six (6) communities has over 27% of households living below poverty; per capita income levels below \$15,920; and unemployment rates above 15%, nearly three times the current national average. Additionally, one community area within the WSDA – West Garfield Park (Area 4) – has the lowest life expectancy in the City at 68.6 years old. The below table breaks down vulnerable populations in the WSDA by community area:

	Austin (Area 1)	Humboldt Park (Area 2)	East Garfield Park (Area 3)	West Garfield Park (Area 4)	North Lawndale (Area 5)	South Lawndale (Area 6)	WSDA Total
Change in population from 2000 to 2010*	-16.2%	-14.4%	-1.5%	-21.8%	-14.0%	-12.9%	-14.3%
Hispanic or Latino*	8.9%	53.3%	4.1%	1.9%	6.0%	82.6%	34.9%
Black or African American*	85.1%	40.9%	90.9%	96.2%	91.4%	13.1%	60.3%
65 years+*	10.8%	7.3%	8.7%	10%	8.9%	5.1%	8.3%
Median HH Income*	\$31,885	\$29,778	\$25,108	\$24,502	\$23,388	\$32,837	\$27,917
Unemployed (16 years+)*	22.6%	17.3%	19.5%	25.8%	21.2%	15.8%	19.8%
Disabled or accessibility challenges	10%-19.9%	5.9%-36%	10%-36%	5%-36%	5.9%-36%	5.9%-19.9%	5%-36%
Below Poverty**	27%	32.6%	39.7%	40.3%	38.6%	28.1%	34.2%
Crowded Housing**	5.7%	11.2%	7.5%	8.9%	7.2%	17.6%	8.6%
No High School Diploma**	25%	36.8%	26.2%	26.2%	30.4%	58.7%	30.2%

Per capita income**	\$15,920	\$13,391	\$13,596	\$10,951	\$12,548	\$10,697	\$13,504
Non-English speakers	<10% - 24%	<10% - 62%	<10%	<10%	<10% - 24.9%	10% - 62.5%	<10% - 62.5%

* Census data (CMAP)

**Chicago Health Atlas

There are additional environmental factors that exist within the WSDA that make these communities more vulnerable than other areas of Chicago. An analysis of Chicago's stocking data reveals that the WSDA has an estimated 67% stocking level of trees, or a potential of 33% plantable spaces, compared to a 77% stocking level in the greater surrounding central region of the city.

There are unmet recovery and resilience needs specific to lower income households in the WSDA. For example, many renters and crowded households (approximately 10% of the WSDA) have their main living and sleeping spaces in the basement, and a flood will displace these residents. Chicagoans with higher incomes that live in homes with higher property values can better prepare for and respond to flooding and more often have resources to purchase private insurance, maintain their property, retrofit their plumbing systems, or afford post-storm clean up. Single-family homeowners with higher incomes also typically don't have their main living spaces in the basement. The median household income for the WSDA is \$27,917. These individuals do not have the financial means to retrofit their homes or move. The estimated cost to retrofit a home in the WSDA ranges from \$5,500-23,500, or 20-84 percent of the average household income for these communities. Further, approximately 10% of the WSDA's population is elderly. Elderly residents are disproportionately impacted by flooding since they often have accessibility challenges and less physical ability to clean up after floods.

Many of the neighborhoods most at risk from flooding are also those that suffer from population loss and high levels of vacancy. While many factors contribute to depopulation,

basement flooding can be a tipping point event for residents, triggering them to leave their community and move out of the city. This has significant consequences for social stability and the economic prosperity of Chicago's neighborhoods. The WSDA suffers from population loss (its population decreased 14% between 2000 and 2010), housing and commercial decline, private disinvestment, and a rise in vacant land and buildings.

Social, governmental, educational, environmental, or economic factors contributing to disaster recovery and resilience in Chicago include ongoing and planned actions to reduce vulnerability and revitalize Chicago's neighborhoods. In 2013 Chicago developed Sustainable Urban Infrastructure Guidelines that incorporate requirements for all new roadwork projects to enhance long-term resilience, including considerations for stormwater, heat and reflectivity, recycled content and placemaking. The City has implemented a Stormwater Ordinance, directing new developments along the inland waterway to send their stormwater to the river and developed pilot projects in neighborhoods, at schools and on residential blocks. In 2013 the Chicago Plan Commission (CPC) adopted the *Chicago Sustainable Industries (CSI): A Business Plan for Manufacturing*. Initiated by DPD with Economic Development Administration funding, CSI provides strategies and actions for small and medium-sized manufacturers; coordinates government agencies around shared goals; and provides a framework for infrastructure investment that broadens the foundation for public and private-sector success. DPD and the Illinois Manufacturing Excellence Center (an MEP center) developed a program for a 10-year collaborative stemming from this process. In 2013 CPC adopted *A Recipe for Healthy Places*, based on Mayor Emanuel's Healthy Chicago plan, to guide planning and policymaking, and individuals seeking healthier lifestyles. More than 400 nutritionists, gardeners, community activists, child care providers, food entrepreneurs, academics, and residents participated in over

24 public workshops. Also, Chicago has seen a significant reduction in violent crime as a result of a coordinated effort across City departments, sister agencies and community partners to take a more holistic approach to safety by increasing investment in evidence-based violence prevention programs, strategic policing, and school-based reforms. The City has increased access to high-quality science, technology, engineering and math education learning experiences beginning in early childhood through college and career. Last, the Retrofit Chicago Residential Partnership between non-profit groups and utility companies connects residents to home retrofit contractors, free energy upgrades, and equipment rebates.

Social, governmental, educational, environmental, or economic factors hindering disaster recovery and resilience in the WSDA are decades of housing and commercial decline, private disinvestment and a rise in a vacant land. Looking forward, the WSDA will continue to be vulnerable to flooding from the increased and more severe storms and heat events we are seeing because of climate change. Further, the WSDA has high incarceration rates. Between 2005 and 2009, it is estimated that the State of Illinois spent \$1.1 billion in incarceration costs for residents from blocks within the top three community areas with the highest incarceration spending in the city – Austin (Area 1), Humboldt Park (Area 2), and North Lawndale (Area 5) – all within the WSDA (chicagosmilliondollarblocks.com).

D.c. Appropriate approaches. Based on the information above and input from stakeholder consultation, the CDBG-NDR optimal activity or program to improve disaster recovery and resilience in the WSDA, City of Chicago, and the greater region or state, is a concentrated green infrastructure program with projects tailored to each community area incorporating a combination of block-level and public facility enhancements, vacant commercial land upgrades, greenspace creation, industrial property conversion, residential home improvements, and street

tree installations. These projects both address stormwater management, and provide potential co-benefits including urban heat island reduction, recreational opportunities, social cohesion, community health improvement through reduction in asthma and heat-related illnesses, reduction in heating and cooling energy costs, job creation in green landscaping and construction, workforce development, and economic revitalization.

Alternative projects included traditional gray infrastructure stormwater solutions that would require prohibitively large upfront capital investments and funding for long-term maintenance. This traditional approach would not provide multiple benefits for these communities, and would not build resilience. Economic and social conditions would be unchanged, streets and corridors that would be improved and revitalized would remain in their current states, and the project would have no effects on urban heat island conditions.

From its consideration of evidence analyzed during the NDRC process, the CRT has drawn the conclusion that in order to limit the effects of future shocks and stresses, the City must work to develop, model, and implement requirements and standards for how future projects can be more resilient under a changing climate and other stresses. Through WSDA projects, the City must support homeowners and business owners with assistance for resiliency measures that reduce the flooding and create multiple benefits. Chicago's housing recovery and assistance programs, in line with programs approved through the City's CDBG-DR Action Plan, must advance sustainability and resiliency measures by focusing on modern building standards, green building technology, and energy efficiency into the reconstruction process, where feasible. The City must prioritize the needs of LMI households in its homeowner and renter programs. This proposal must build on many ongoing and planned actions to reduce vulnerability and revitalize Chicago's neighborhoods, including Building a New Chicago, Chicago Neighborhoods Now, the

Green Stormwater Infrastructure Strategy, and Sustainable Chicago 2015 projects.

The most appropriate recovery approaches or types of action to meet Chicago's unmet recovery and revitalization needs and address the City's community development objectives, including increasing resilience to current and future hazards and threats, is an approach that has quantifiable benefits for the WSDA that extend to the City of Chicago and larger Cook County region; correspond to the region's unmet recovery needs in Housing, Infrastructure, and Economic Revitalization, and resiliency; and take into account climate change.

First, the approach must be holistic. Chicago is taking a holistic approach to assess risk from flooding and other hazards and designing a program that comprehensively reduces these risks. This approach includes three primary components: (1) Regional collaboration through the Partnership provides a coordinated effort to collect data, engage residents and local businesses, implement demonstration projects, create new policies, and develop a region-wide plan for improving resiliency to flooding and other climate impacts. (2) Comprehensive planning to reduce flooding within Chicago through doubling the City's investment in water infrastructure to replace aging infrastructure and improve service to Chicagoans, including over \$250 million annually to expand and modernize our sewer network and a \$50 million commitment over five years to construct green stormwater infrastructure. These investments are targeted at the most flood-prone areas and are thoroughly analyzed using DWM's state-of-the-art hydraulic computer model to optimize project design and determine the most cost-effective projects. The City will continue to utilize this science-based tool and will incorporate climate change projections into project planning and engineering through our ongoing partnership with the University of Illinois, the Illinois State Climatologist, and National Oceanic and Atmospheric Administration. (3) Through participating in 100 Resilient Cities, Chicago is hiring a Chief Resilience Officer to

develop a citywide resilience strategy to address risks to the environment, public health, the economy, and social systems. These efforts build on existing efforts, including the Chicago Climate Action Plan, Sustainable Chicago 2015, and Building a New Chicago.

Second, the approach must be scalable, replicable, and measurable. Chicago will bring to scale, integrate, and measure in the WSDA a range of strategies and techniques that have been piloted in disparate communities throughout the City over the past 15 years. The strategies developed for the WSDA will serve as a model for the rest of Chicago, for the region, and for communities nationally and globally facing similar challenges. The City of Chicago is working with the Partnership to develop and implement a regional resilience framework that maintains and improves the quality of life by minimizing exposure, reducing sensitivity, and increasing the built, natural, and social systems adaptive capacity to current and future hazards, stressors, and shocks. The Partnership is working to expand the scope beyond flooding to encompass an “all-hazards” approach to resilience that addresses extreme heat, drought, economic competitiveness, and ecological and social vulnerability. Related data-driven, systemic solutions will deliver multiple benefits in an innovative and cost effective manner; effectively engage local stakeholders and the public including vulnerable populations; and create lasting benefits. Successful interventions will be replicated throughout the region. Chicago’s proposed projects will serve as pilot studies of flooding solutions across the City’s most common land use types and are also representative of the spectrums of social, ecological, and built conditions and vulnerabilities found across the City and greater region.

Third, the approach must have multiple benefits. By integrating the strategies set forth in this proposal in the WSDA, the City can reduce flooding risk while also providing multiple benefits that boost economic development, enhance property values, strengthen social

connections within neighborhoods, enhance public health, and improve environmental conditions through increasing the tree canopy and reducing urban heat island effects. The projects planned through this NDRC proposal that reduce flood risk, particularly green stormwater infrastructure and home retrofits, can boost economic development and community revitalization by generating jobs and new workforce development opportunities, as well as enhancing property values. For example, by tasking Greencorps with 15% of construction for planned projects will create 100 jobs per year in the WSDA. Further, these solutions address other environmental challenges such as urban heat island effect.

Finally, the approach must involve community and stakeholder input. Through its outreach in the WSDA, the CRT learned of an expressed need from the community for public education regarding resiliency building.

EXHIBIT E: SOUNDNESS OF APPROACH

E.a. Sound Approach Description: Throughout the process to create the Phase 1 and 2 applications, the City of Chicago has followed a data-driven, community-based approach that simultaneously will reduce flooding, increase resilience, and revitalize one of the nation's most vulnerable urban areas.

Chicago's approach to program development included four main steps: 1) identified a target area that is the most at risk from the impacts of flooding on vulnerable populations; 2) engaged with the target community stakeholders and partnered with regional collaborators; 3) evaluated potential strategies that will reduce flood risk while simultaneously providing resilience, environmental, social, and economic benefits; and 4) modeled and optimized resilient revitalization implementation scenarios that will most cost-effectively deliver benefits to Chicago's vulnerable West Side neighborhoods.

The result of this process is the creation of the Resilient Revitalization Program that will invest in stormwater infrastructure, develop affordable housing and economic renewal, protect homes from flooding, and rebuild critical community assets such as schools, streets, and parks. Chicago's approach to program implementation includes three primary program components: Engage, Build, and Measure. First, the Chicago Resilience Team will work with the Community Resilience Council (described below) to engage with citizens and key community stakeholders in the WSDA to ensure that program elements meet their needs. Second, the City will build and renew infrastructure to revitalize communities and reduce flooding risk. Third, the City will measure and evaluate the impacts of these resilient investments to establish a national model that can be scaled and replicated throughout City and across cities throughout the country.

Resilient Revitalization Program Development Approach: As described in Chicago's Phase I

application, the City's first step was to identify the most vulnerable citizens at risk of flooding.

Identify target area at nexus of flood risk and vulnerable populations: In order to meet the goals of the National Disaster Resilience Competition (NDRC) the City identified the area that is most at-risk from the impacts of flooding on vulnerable populations. The City used a prioritization process that overlaid heat maps showing (1) Economic Hardship Index Score and (2) Concentrations of 2013 Storm FEMA individual and household assistance recipients. The City drew boundaries over three areas that showed the nexus of damage and distress with high levels of economic hardship and concentrations of FEMA assistance, and aligned with community boundaries and planning study areas. The City also reviewed hydraulic modeling and sewer capacity information for these areas. Based on this data, the City selected six Community Areas in the West Side of Chicago as its target area (the WSDA) for NDRC planning and project work. The City selected the West Side area as it had the highest concentration of economic hardship and a substantial number of FEMA-assisted households. The area also contains the three primary land use types in the City – making it an ideal location to model and test resilience initiatives that can be scaled and replicated in other areas.

The WSDA includes the 94 census tracts that make up the six Community areas of Austin, Humboldt Park, East Garfield Park, West Garfield Park, North Lawndale, and South Lawndale. Investments in the WSDA will help alleviate and reduce flooding in communities where the financial need is greatest and will overwhelmingly benefit minority communities. 88% of these census tracts are Low-Moderate Income areas. Blacks and Hispanics make up over 90% of the population in these areas. Each community has over 28% of households living below poverty; per capita income levels below \$15,957; and unemployment rates above 15%, nearly three times the current national average. In its four main zip codes (60623, 60624, 60644, and

60651), 2,900 residents received over \$6.3 million in FEMA Household Assistance as of October 2013.

Consultation and community engagement: After the City selected the West Side communities as the target area, the City began an intensive process of regional consultation and community engagement.

Regional consultation: The City is collaborating across sectors, fields and geographies through the Partnership. The Partnership serves as the multi-governmental coordinating body of resiliency planning and activities across the region, and coordinates with the City of Chicago on crosscutting resilience activities that affect the entire region. The Partnership includes Cook County, DuPage County, the State of Illinois, the Chicago Metropolitan Agency for Planning, and many other jurisdictions and non-governmental stakeholders. This regional approach supports shared flooding and climate change threats and risks with the goal of coordinating coordinate local solutions so as not to exacerbate downstream problems and fail to address policy areas that are best addressed at the regional or statewide level. The Partnership will pilot, scale, and collaborate on successful resilience strategies across the region and state. It serves as a model for the network of regional resilience partnerships that will form across the state, with the aim of sharing lessons learned and advancing best practices.

In Phase 1, the Partnership convened 27 regional meetings with 275 stakeholders representing 170 organizations, including 35 non-profit and community-based organizations, 61 businesses, 41 governmental units/departments, 15 research institutions, and eight local foundations. During Phase 2, the Partnership convened 10 regional meetings with stakeholders representing 79 organizations, including 27 non-profit and community-based organizations, 19 businesses, 24 governmental units/departments, 6 research institutions, and three local

foundations. In Phase 2, the Partnership met with 40 new organizations on top of the 170 that had been engaged in Phase 1. The Partnership also convened focused sessions and webinars on the topics of insurance and financing. The work of the Partnership informed the City's program development approach, and the Partnership will play a key role in the City's implementation approach as described below.

Community outreach: The City engaged a broad spectrum of community stakeholders including residents, commercial and industrial businesses, community-based non-profits, City of Chicago delegate agencies, schools and active neighborhood groups. Input was received and integrated into the City's program development through multiple channels.

Immediately after the City submitted the Phase 1 application, DPD staff met with stakeholders in each WSDA neighborhood to identify priority areas of need and where investment in resilience could enhance existing program and planning efforts and community activity. Between May and September 2015, the City consulted 45 community organizations (see attached Consultation Summary). The City also held targeted meetings with manufacturers located in the industrial corridors within the WSDA to discuss opportunities for constructing green stormwater infrastructure in underutilized areas on private land within the corridors. The feedback received by the City during these meetings directly informed the creation of specific project areas boundaries and helped with the selection of commercial corridors, residential streets, parks, and school for further evaluation and modeling.

In September, the City held five workshops to present an overview of resilience planning, explain the benefits of green stormwater infrastructure, and illustrate how green stormwater infrastructure could be applied to the various land use types and proposed project areas within each community area. The City mailed or emailed a double-sided (English/Spanish) flyer

announcing the workshop dates and locations to nearly 500 residents that have been identified by the City has having backyard gardens and roughly 250 participants in the City's Large Lot Program. Students participating in the Garfield Park Community Council Green Team also canvassed several hundred homes in the Garfield neighborhoods. Multi-lingual facilitators were present at every workshop. Each meeting began with the Flood Resilience Presentation and was followed by smaller group dialogues with residents focused on their specific neighborhoods, blocks, and properties. Residents identified their local challenges including flooding (sewer backup and street, often related to viaducts), heat, economic distress, social isolation, and limited infrastructure, and brainstormed ideas by writing on neighborhood maps prepared by DPD. All area Aldermen were briefed prior to these meetings.

As part of the City's CDBG-DR Action Plan, DPD and its delegate agencies are working to engage further with impacted and distressed communities, including those in the WSDA. In managing its CDBG-DR funding, the City is working to strengthen its resilience approach in vulnerable areas and re-asses information on infrastructure challenges with flooding, specifically as it relates to the City's viaducts, vaults, streets, and parks. As part of its CDBG-DR Action Plan, the City is working with five delegate agencies to continue to address 100 open case files of people with unmet needs and to revisit over 700 residents with verified loss to bring these homes to resilient standards. Most of the case files pertain to residents on the south side of the City, as well as within the WSDA. This work will deepen the City's understanding of challenges in these areas while opening the door to other programs, such as the City's Retrofit Chicago residential energy efficiency program, which includes access to partner offerings including a no cost "direct install" program of standard efficiency measures for residents. For a comprehensive list of the City's consultation efforts to date, see Attachment D: Consultation Summary.

Analyze strategies: Building on the community engagement and regional consultation process, the City identified alternatives and evaluated strategies that will both reduce flooding risk and increase resilience within neighborhoods. Through a collaborative process, the City identified a suite of stormwater management investments termed green stormwater infrastructure as the best approach to achieve multiple goals. Unlike traditional grey stormwater infrastructure investments, such as expanding wastewater treatment plants and building additional deep tunnel storage systems, green stormwater infrastructure captures and manages rainfall while also providing a multitude of community enhancements and resilience, social, environmental, and economic benefits.

For many years, the City has demonstrated leadership and expertise in building green stormwater infrastructure. From green roofs and green alleys to permeable pavements and streetscape infiltration planters, Chicago has led the nation in these innovative strategies. Chicago will build on these efforts and create a program that moves beyond pilot projects and implement green stormwater infrastructure at scale and within vulnerable neighborhoods. By concentrating many green stormwater infrastructure installations in select neighborhoods, Chicago will demonstrate that building multiple types of green stormwater infrastructure projects can create benefits that are greater than the sum of their parts. This approach, Chicago's Resilient Revitalization Program, will be unique within the U.S. since no city has yet to build such a wide variety of green stormwater infrastructure strategies in one place, and then paired this strategy with policies such as workforce development of neighborhood residents, many of whom have barriers to workforce entry, and layered on measurement and monitoring that will demonstrate a wide range of benefits to allow scalability and replicability.

To develop this program, the City evaluated the land use patterns of the West Side

Demonstration Area and determined that these communities, like the rest of Chicago, largely consist of three main land use types: residential, parks and open spaces, and commercial and industrial. We then analyzed common land use types that exist within these land use categories, including public facilities, residential and commercial streets, alleys, parks, historic boulevards, industrial properties, single-family homes and multi-family housing complexes, and vacant land on public commercial corridors and residential blocks.

Next, the City evaluated specific green stormwater infrastructure interventions that could be built on these land use types. Specifically we modeled strategies using the U.S. EPA's Stormwater Management Model (SWMM) to determine stormwater performance. These strategies include bioretention and infiltration, detention, permeable pavement, rainwater harvesting, urban agriculture, vegetated roofs, and downspout disconnections of residential buildings. We matched stormwater performance data for these green stormwater infrastructure strategies with best available data from Chicago and other cities to establish indirect and capital costs, engineering and construction schedules, lifespan, maintenance costs, and, ultimately, which strategies are most cost-effective.

Model and optimize implementation scenarios: Once the City determined which green stormwater infrastructure strategies could be cost-effectively implemented at scale in Chicago's neighborhoods, the CRT modeled the flood risk reduction benefits and optimized potential implementation scenarios to create a program that will deliver the greatest package of benefits to the WSDA. This effort relied on the City's existing hydraulic computer sewer model, which is one of the most advanced InfoWorks-based stormwater models of its type in the country. The City evaluated the entire West Side Demonstration and established five distinct project areas that span the six community areas based on feedback from community organizations and public

meetings. Within these five project areas, the City and its consultants went through an iterative hydraulic computer modeling process to determine which blocks, streets, and parks could be modified through green stormwater infrastructure. This work was done concurrently with the BCA process by the same consultant team, ensuring that selected strategies and areas were optimized both for flood risk reduction and cost-effectiveness. Initially the City modeled a full implementation scenario for green stormwater infrastructure for the five project areas, but the level of proposed investment was refined and reduced to maximize cost-effectiveness.

Resilient Revitalization Program Implementation Approach: The City has analyzed and optimized an implementation scenario that is included within the BCA, schedule, and budget. Due to the complexity of the program and the need for additional community engagement, design and engineering, the City will make many decisions about implementation and final site selection following the launch of the program. To lead and manage this program and ensure an effective decision-making process, the City has developed an implementation structure that will be led by the Office of Mayor Rahm Emanuel and include the work of numerous city and sister agencies, community organizations, technical experts, and regional partners.

This implementation management structure includes six distinct components. First, the program will be overseen by program management staff in the Mayor's Office. Second, an Executive Committee that includes the Commissioners of DPD, DWM, OBM, CDOT, OEMC, and DSS plus the Chief Operating Officer, the Chief Sustainability Officer and the Chief Resilience Officer from the Mayor's Office who will provide long-term strategic direction and resolve inter-departmental disputes. Third, a Working Committee with Deputy Commissioners and Project Managers from the City agencies represented in the Executive Committee plus other key agencies, such as CDPH, CPS, CHA, the Parks Department, and CTA, will provide overall

project management. This Working Committee will also determine capital allocation and site select, provide coordination between departments, provide short-term strategic direction, and inform and engage Commissioners and Directors. Fourth, key City agencies, including CDOT, DWM, the Parks Department, and CPS, will implement capital projects on streets, parks and schools using existing and new funding. Fifth, technical partners and delegate agencies, working with a Community Resilience Council as described below, will implement projects on residential properties, industrial land, and vacant parcels. Last, a measurement and metrics team comprised of Argonne National Laboratory, the University of Chicago, and UI Labs will evaluate the effectiveness of the investments across resilience, environmental, social, and economic categories. Through this program leadership and management structure, the City will successfully carry out the three primary program implementation approach components: Engage, Build, and Measure.

Engage: The first step to implement Chicago's resilient revitalization program will be to continue engaging the community as a partner in selecting, designing, building, and maintaining policies and projects. The City will create the Community Resilience Council, which will consist of six neighborhood delegates, five housing organizations who will provide technical assistance, environmental and manufacturing stakeholders, and other key resilience community partners. See Capacity and Partnership Agreements for more information.

The City will continue to engage other jurisdictions and key stakeholders throughout the region by playing a critical role in the Northeast Illinois Resilience Partnership. The Partnership's approach during program implementation can be divided into two key efforts. First, the Partnership will facilitate cross-jurisdictional coordination. Aligning efforts across boundaries, will achieve the goal of scaling up successful interventions to create impact in

communities across the region and state. This coordination is meant to improve the level of innovation and quality of pilot projects, ensure that impacts are considered across jurisdictions, improve the state of practice for building resilience, and ultimately develop a rubric for resilience planning that can be used across the region, state and country. Second, the Partnership will create a *Regional Resilience Framework for Action*. Recognizing that building regional resilience is bigger than any one entity or community, the Partnership has identified shared priorities that will inform a regional approach. The Partnership will work together to advance 10 priority areas: 1) examine and propose revisions to key regional and statewide policies; 2) create workforce development and training programs; 3) develop better data sources, such as revised rainfall duration and frequency calculations that reflect climate change; 4) collaborate on better modeling, such as improving regional climate change models; 5) create models new networks that enhance capacity and knowledge; 6) establish mechanisms for scaling successful strategies through the region and state; 7) create regional and statewide metrics that track progress and evaluate effectiveness; 8) perform monitoring and evaluation to inform replicability and scalability across the region and state; 9) improve financing options by commissioning a formal assessment of optimal revenue generation options; and 10) coordinate and co-brand education and outreach campaigns.

Build: Chicago's proposed program anticipates significant investments through the construction of green stormwater infrastructure, residential retrofits, affordable housing development, and improvements to local sewers. These include investments on both public and private property and represent a holistic approach that will reduce flood risk will also providing resilient revitalization.

Chicago and its key sister agencies will build green stormwater infrastructure projects

that will renew critical public infrastructure assets. The Chicago Park District will renew and restore major historic parks such as Garfield, Humboldt, Columbus, and Douglas Parks, to manage over 450 acres of stormwater drainage area. CPS will build green stormwater infrastructure to manage runoff from 119 acres at over 20 public elementary, middle and high schools. CDOT and DWM will build green stormwater infrastructure to create commercial complete street on over 60 blocks of Chicago Avenue, 5th Avenue, 16th Street, 26th Street, and 31st Street; build 7 blocks of residential complete street on Central Avenue; retrofit 30 blocks of planted medians on Franklin, Sacramento, Douglas, Marshall, and California Boulevards; and construct 45 blocks of Green Alleys. All of these streetscape and right of way projects will manage stormwater from a drainage area of over 120 acres.

Chicago will work with technical partners and private property owners to implement projects on private property, industrial lands, and vacant parcels. This includes retrofitting over 7,600 homes, 40 acres of industrial properties, and 261 vacant parcels to capture runoff from over 830 acres of land.

Chicago will also incorporate green stormwater infrastructure into publicly-funded affordable housing developments. Within the WSDA project areas, private developers, supported by public financing and incentives, will build 6 housing developments to provide 519 units of affordable housing. These projects total \$134,656,622 million in development. These developments will incorporate stormwater management features to fulfill the City's Stormwater Ordinance, and the City will work with the private developers to build additional green stormwater infrastructure onsite or adjacent to these projects.

Chicago will also directly leverage over \$21 million in investments by DWM in 13 sewer replacement projects within the WSDA project areas. These projects will construct 4.75 miles of

new sewers, thus increasing stormwater capacity and eliminating choke points in the sewer network. In addition, 17 sewer projects totaling almost \$28 million within the WSDA but outside the project areas will provide supporting leverage to the City's program. These projects will incorporate green stormwater infrastructure through permeable pavement restoration, where feasible, and/or additional investments in trees or bioretention planters in the parkways adjacent to the curb.

Chicago will enhance the social and economic value of these infrastructure and construction projects by incorporating Greencorps, the City's green industry job training program for individual with barriers to employment. Greencorps' mission is to promote environmental stewardship and improve the quality of life in Chicago by establishing, maintaining and restoring natural and public spaces that are safe, healthy and sustainable through hands-on involvement with trainees. For this proposed program, Greencorps will work on a variety of project types as they are well-suited to construct many of the green infrastructure treatments planned for the WSDA project areas. Trainees have installed permeable paving, rain gardens, prairies, and wetlands, and have even conducted door-to-door campaigns to disconnect residential downspouts and install rain barrels. Most importantly, during the nine-month program the trainees are educated about natural areas stewardship, proper care and maintenance of trees, bioswales, and habitat, and they bring this knowledge back to their home communities, serving as permanent, on-the-ground ambassadors.

Chicago will also incorporate key policy changes to increase the level of resilience investments for the program components identified above as well as other projects built throughout the City. These policy changes include full adoption of stormwater management and resilience standards for CDOT's Sustainable Urban Infrastructure Guidelines and the

forthcoming Placemaking Guidelines. These documents, plus the Complete Streets Design Guidelines, outline key CDOT principles that seek to ensure resilience through the careful planning of the City's public right-of-ways. The Sustainable Urban Infrastructure Guidelines and Policies are structured around eight (8) environmental themes: Water; Energy; Materials & Waste; Climate and Air Quality; Beauty & Community; Urban Ecology; and Commissioning. Under each Category, regionally specific objectives are listed. For Water these include: reduce basement and street flooding; reduce combined sewer overflow events and volumes; reduce potable water use; clean and direct stormwater to natural water bodies; reduce non-point source pollution to natural water bodies; and ensure erosion and sediment control. Importantly, the requirements scale over time. The original base-line requirements were set in 2013; they increased in 2015 and are set to increase again in 2018. The forthcoming Volume II of the Sustainable Urban Infrastructure Guidelines provides implementation strategies for these requirements, performance metrics for each strategy, and resources.

Feasibility: The City has developed a program that is very feasible for many key reasons. First, the City and Sister Agencies that will manage this program and build most of the infrastructure already have expertise and experience designing and building green stormwater infrastructure. Second, the City has a large pool of available consultants who can be utilized for planning, design, engineering, and construction. Third, the scale of the proposed program is well within the scope of the City's capabilities. To illustrate this, the City currently manages almost \$1.1 billion in Federal funding and has the expertise to fulfill all requirements for administration, environmental assessment, reporting. Also, the City is equipped to implement large capital programs as demonstrated by the almost \$9.5 billion that is being invested through the 5-year capital plans (2015-2019) by the City (\$7,974,548,982), CPS (\$1,237,869,630), and the Park

District (\$278,000,000). Fourth, the City is currently implementing a \$122.475 million disaster recovery program that uses \$63.075 million in CDBG-DR funds matched by \$59.4 million in City and other funds. This experience has provided the City with the knowledge and the proposed partners to successfully implement a residential retrofit program on private property.

Measure: A unique aspect of this proposed program is a comprehensive approach to monitor results and evaluate effectiveness of the City's investments on resilience, environmental, economic, and social indicators.

The City's approach to measuring and monitoring the effectiveness of this proposed program will include innovative partnerships with three leading research institutions: Argonne National Laboratory, The University of Chicago, and UI LABS. The City is partnering with Argonne National Laboratory to create a platform for collecting and analyzing data on a wide range of indicators. This effort will build on the Array of Things projects, which is an urban sensing project that uses a network of interactive, modular sensor boxes that will be installed around Chicago to collect real-time data on the city's environment, infrastructure, and activity for research and public use. This project, led by researchers from the Computation Institute's Urban Center for Computation and Data, a joint initiative of Argonne National Laboratory and the University of Chicago, recently received a \$3.1 million National Science Foundation grant to fund the development and installation of 500 Array of Things sensor nodes: ornamental enclosures containing instruments for measuring various components of the urban environment such as temperature, barometric pressure, light, vibration, carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, ambient sound intensity, pedestrian and vehicle traffic, and surface temperature. Sensor nodes will be located in the WSDA project areas and integrated with projects.

The City will work with UI LABS, in partnership with Argonne National Laboratory, to measure the effectiveness of the green stormwater infrastructure investments to reduce flow to the City's overburdened sewer network. UI LABS is a Chicago-based research and commercialization collaborative, bringing universities and industries together to define problems, design partnerships and deliver scalable solutions to tomorrow's most important challenges. This partnership will build on an existing green stormwater infrastructure monitoring pilot that is underway between the City and UI LAB's City Digital program, including their partners from the University of Illinois Urbana-Champaign, Microsoft, Com Edison, and Accenture. This monitoring pilot will quantitatively assess the effectiveness and performance of the design of green stormwater infrastructure in Chicago by deploying innovative sensors and software tools for five urban streetscapes. The performance of individual green infrastructure designs will be evaluated by measuring storage capacity and infiltration rates, and will characterize environmental and economic sustainability trade-offs across different scales. The outcomes of this project will inform decision-making by the City of Chicago and other similar municipalities of varying scale through: 1) the development and testing of technologies used to collect, transmit, and analyze a corpus of data for green storm water infrastructure performance; 2) an integrated infrastructure and monitoring network linked with life cycle assessment (LCA) to holistically characterize environmental impacts of green vs. gray infrastructure; and 3) a life cycle costing (LCC) framework linking design and operational decisions to internal and external costs and benefits stemming from stormwater management systems at the streetscape level. For the proposed program, the City will locate the fifth pilot monitoring location in the WSDA project area and seek to expand the monitoring of green stormwater infrastructure to determine the effectiveness of the program's full implementation.

Throughout the Resilient Revitalization Program development process, the City created a new quantitative and comprehensive framework to evaluate proposed resiliency solutions across disciplines. The City developed a list of performance metrics within each of the HUD Benefits Categories: Economic Revitalization, Resiliency Value, Environmental Value, and Social Value (see full table of metrics in Regional Collaboration and Long-Term Need Section). These measures were developed based on stakeholder input, subject matter expert insights, community feedback, and a review of recent resilience measurement literature. The Resilience Team will conduct a baseline measurement on all metrics beginning in November of 2015 and produce a baseline report January 2016. Each year, the team will collect the metrics data and produce a report on the progress within each of these measures throughout the performance period. Additionally, the team will conduct an informal review of each metric every June to identify any major challenges or barriers adversely impacting each measure and implement corrective action as necessary. The City will report its metrics to the Regional Resilience Partnership for collective impact assessments. The City will also consult local Academic Institutions on analysis of the social impacts of the proposed projects.

Replicability and Scalability: The ability to replicate and scale a solution for urban flooding and resilient revitalization has been a fundamental consideration throughout the City's approach to program development and implementation. The economic, social, and environmental challenges and opportunities that face Chicago's West Side communities also exist throughout many other neighborhoods within the city, throughout the Chicago region, within the State of Illinois, and in communities across the country. The key factors that make Chicago's Resilient Revitalization Program a model for replicability are the focus on common land use categories as well as its approach to measurement and monitoring.

The physical structure of the city and its neighborhoods are common to cities across the country and even the world. From blocks, streets, and homes to parks, schools, and industrial corridors, the land use categories and configurations that exist in Chicago, and that serve as the framework for the City's proposed Resilient Revitalization Program, also exist throughout the country. The analysis behind this proposal shows that an integrated approach to building resilience through green stormwater infrastructure delivers measurable benefits at the scale of a neighborhood or a project area. Given the common nature and frequent occurrence of homes, streets, schools, and parks, the City could transfer and replicate this program in every neighborhood in the Chicago.

In addition to targeting common land use components, the City is using common and well-established green stormwater infrastructure strategies. While the scope of the program is complex and the City's desire to implement these strategies at scale in a community with many vulnerable citizens is unprecedented in the U.S., the actual individual green stormwater infrastructure strategies have been tried and tested in Chicago. By implementing a large-scale green stormwater infrastructure program, the City will establish standard designs and prototypes for projects such as rain gardens, streetscape bioretention, and green schoolyards. These designs can be used as models for other areas of Chicago and can be shared and replicated in communities across the country.

Another key to the replicability and scalability of the City's proposed Resilient Revitalization Program is the approach to measurement and monitoring. The City's monitoring program will track the amount of stormwater captured by green stormwater and the reduction of flow into and through the overburdened sewer network. This data, combined with information about costs for design, construction and maintenance, will determine the long-term cost-

effectiveness of green stormwater infrastructure to reduce flooding and increase resilience. This evaluation of the cost-effectiveness of green stormwater infrastructure is critical for Chicago and other cities. While the proposed program will substantially improve flood risk for residents of the WSDA project areas, this investment won't provide full resilience for all of the residents of the WSDA or the rest of the City. The City will still have significant remaining needs to address flooding and stormwater infrastructure even after implementing this program, and the monitoring and evaluation approach through this program will enable the City to replicate and scale these strategies. The data and results from this program will be critical for additional evaluation of the most cost-effective stormwater management solutions citywide and throughout the nation.

The City will also advance the replicability and scalability of the proposed Resilient Revitalization Program will also by integrating these investments into existing and future plans. This proposed program builds on and helps to achieve the Green Stormwater Infrastructure Strategy, released in 2014, and the Sustainable Chicago 2015, released in 2012 and set to be updated in 2016. This proposed program also will be a key component of the forthcoming resilience plan that Chicago will create in 2016 as part of the Rockefeller Foundation's 100 Resilient Cities program.

E.b. BCA: The City completed a BCA that analyzed the set of projects that would yield the highest resilience, social, environmental, and economic benefit to the West Side Demonstration Area in consideration of the resources available. The draft BCA (see BCA attachment) quantifies the benefits across project areas and achieves a Benefit Cost Ratio of approximately 2.0.

E.c. Scaling/scoping: The City will scale and scope the program to ensure that benefits are accruing to all project areas throughout the life of the program. Following an initial time period for procurement and contracting, the City will first implement those projects that can be built

most quickly. This includes home retrofits and green stormwater infrastructure on vacant lands. The City will then build those public infrastructure projects that require a longer time period for community engagement, design, environmental review, procurement and construction. These include complete street projects, public facility enhancements and sewer reconstructions.

E.d. Program Schedule: The City created the program schedule below to account for the amount of time that will be necessary to fully build and implement the program. Given the scale of the investment and the long lead times that are necessary for complex public infrastructure projects, the City will request a waiver to allow for the obligation of CDBG-DR funding through the end of 2020. The program schedule below includes the implementation timeframe for key steps under community engagement, building public infrastructure, and measurement and evaluation.

Tasks		1	2016				2017				2018				2019				2020			
		5																				
		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Program Management																						
Chicago Resiliency Team meetings																						
Executive Committee Meetings																						
Federal award & funding alignment																						
Engagement																						
Community Resilience Council																						
Street & Park-Specific Task Forces																						
Climate Smart Neighborhood Tool																						
Little Village & North Lawndale Plans																						
Implementation																						
Contracting																						
Public Infrastructure	Public Facilities																					
	Vacant Commercial Land																					
	Parks																					
	Neighborhood Complete Street																					

[illegible]

E.e. Budget: The City’s proposed budget shows a request to HUD for \$200,000 million in CDBG-DR funding to be directly leveraged by approximately \$235 million in committed funds by the City and other partners.

Summary Budget for HUD National Disaster Resilience Competition			
	Grant	Leverage	Total
Administrative cost @ 5% of grant	\$9,325,302	\$0	\$9,325,302
Public facilities and infrastructure	\$132,755,554	\$214,101,233	\$346,856,787
Housing projects	\$38,118,111	\$14,315,892	\$52,434,003
Economic Revitalization	\$19,801,033	\$7,436,606	\$27,237,639
Total	\$200,000,000	\$235,853,731	\$435,853,731

E.f. Consistency with Other Planning Documents: The City’s proposed program is consistent with other planning documents that address issues related to regional sustainability, mitigation, and transportation.

Consistency with Consolidated Plan and/or Regional Sustainability Plan: The City's proposed program is consistent with the City's 2015-2019 Consolidated Plan and the 2016 Action Plan. The Consolidated Plan sets forth priorities for the City's housing and non-housing community

development needs for each calendar year and serves as the City's annual funding application to HUD for the following formula grant programs: the Community Development Block Grant (CDBG); the HOME Investment Partnerships Program (HOME); the Emergency Solutions Grant (ESG) Program; and the Housing Opportunities for Persons with AIDS (HOPWA) Program. Also, this program is consistent with the Chicago Metropolitan Agency for Planning's *GO TO 2040*, which serves as the region's sustainability plan.

Consistency with Mitigation Plan and/or Transportation Plan: The City's proposed program is consistent with the FEMA-approved *City of Chicago City-wide All-Hazard Mitigation Plan: Volume 1 (pages 40-42, 74, 99, 111, Appendix D, Appendix H)* which was created in July 2012. Specifically, this program is consistent with green infrastructure programs identified in the plan; coordination with MWRD and regional jurisdictions; and the implementation of the Chicago Climate Action Plan.

The City does not have a DOT-approved Transportation Plan, but this program is consistent with *GO TO 2040*, which also serves as the region's transportation plan. In October 2014, the *GO TO 2040* comprehensive regional plan was updated in accordance with federal law. It addresses the requirements of the Moving Ahead for Progress in the 21st Century Act (MAP-21) that was signed into law in 2012. *GO TO 2040* addresses multiple aspects concerning the long-term sustainability and viability of the northeastern Illinois region including a section on Livable Communities. This section of *GO TO 2040* addresses diverse factors that together shape quality of life issues. The chapter on Livable Communities includes four sections of recommended actions including Managing and Conserving Water and Energy Resources.

EXHIBIT F: LEVERAGE

F.a. Outcomes and Previous Investments. The West Side of Chicago has been losing population since the 1950s which led to decades of decline and disinvestment. The population of the WSDA in 1930 was 514,326 and has declined to 308,605 in 2010, representing a 40 percent decline over 80 years. North Lawndale and West Garfield Park (two specific communities within the WSDA) saw a loss of 68 percent and 64 percent from 1930-2010, respectively. As a result of this population loss, most of the WSDA neighborhoods have a high number of vacant properties and face a number of related socioeconomic challenges including higher unemployment rates as well as more acute public safety and public health concerns. For example, 2010 life expectancy at birth for West Garfield Park is the lowest of any community area in the city at 68.8 years, which is almost 17 years younger than the highest community area in Chicago at 85.2 years. There have been a number of public investments and planning activities seeking to address such issues and to improve the quality of life for West Side residents. Chicago's NDRC approach will build upon these past efforts and capitalize on the partnerships developed.

Chicago's approach will lead to a comprehensive, self-sustaining Resiliency Revitalization Program that will build resiliency in the WSDA by addressing flooding, boosting community development and improving social cohesion through investments in green infrastructure in the public right of way coupled with investments in community outreach and assistance to property owners both residential and commercial. The Resiliency Revitalization program is based on input from several residents, community organizations, and public agencies, gathered through an iterative process over the past year and focused on conceptual design, strategies for implementation, and measurement of outcomes. Based on this work, Chicago, and

more specifically the WSDA, will serve as a lab that will generate data on aggregating green solutions to yield a broader transformation that will reduce stress on the sewer system and strengthen communities. These strategies developed in the WSDA can then be applied to other parts of Chicago.

The City is already implementing green infrastructure solutions and realizing co-benefits through current projects in the WSDA and across Chicago, including development of urban agriculture spaces, modifications to school grounds that increase community utility and stormwater performance through the Space to Grow program, planning initiatives such as Green Healthy Neighborhoods and Chicago Neighborhoods Now, expansion of the Large Lots program to sell city-owned vacant land for \$1, and the Pilsen Sustainable Street Project. The City has identified potential co-benefits from its proposed project ideas, including improved stormwater management, reduced impacts associated with urban heat island, increased recreational opportunities, improved social cohesion, community health improvement through reduction in asthma and heat-related illnesses, reduction in heating and cooling energy costs, job creation and workforce development, and economic revitalization.

In order to implement its resiliency ideas in an environmentally and financially sustainable way, Chicago will look to the Pilsen Sustainable Street project as a green stormwater infrastructure model. This project addresses a suite of environmental themes, including stormwater best management practices, use of 70 percent local materials, use of 23 percent recycled content in installed materials, and the diversion of 60 percent of construction waste. The project also addresses urban heat island and energy efficiency through a series of innovative materials, supports walking and biking, and enhances economic development. With proper maintenance, green and grey infrastructure investments in the public right of way proposed in

Chicago's NDRC program will last 30-50 years or longer and will add to the benefits above and beyond decreased flooding risk for the WSDA. Chicago's proposed Resiliency Revitalization Program represents sustainable and long term investment in the WSDA.

The City has leveraged its Large Lot program in the WSDA to contribute to community revitalization, reactivate vacant residential parcels, give residents greater control of their neighborhoods, and build wealth for existing property owners. The Large Lot program was originally launched in 2014 and has been available in 11 community areas across the city including two (2) communities within the WSDA. The program has resulted in the sale of over 400 vacant lots to existing property owners, 156 lots were in the East Garfield Park community area. The program was launched in the Austin Community Area in Summer 2014 which will result in the sale of about 80 additional vacant lots. The program can be expanded through workshops educating participants on managing stormwater within their newly acquired vacant lots, which will address the area's blighted property. Additionally, to connect the unemployed in the WSDA to jobs created through projects in the Resiliency Revitalization Program, the City will leverage its existing Greencorps Chicago job training program that provides practical job training and field experience to individuals with barriers to employment in landscaping, ecological restoration, and tree care.

During the development of the Phase II application several community groups indicated a desire to expand urban agriculture ventures on city-owned vacant land in strategic areas or corridors. The City has facilitated the development of several urban farms and community gardens in a variety of neighborhoods. In 2014 DPD partnered with NeighborSpace and Heartland Human Services (HHS) to develop an urban farm on several city-owned vacant and environmentally contaminated parcels in the Humboldt Park community. The project involved

environmental remediation and development of a 2.5 acre farm at a total cost of approximately \$1.8 million. The farm is owned by NeighborSpace and operated by HHS as a job-training and food production facility specializing in workforce development for individuals with barriers to employment. All produce grown on site is sold to the Greater Chicago Food Depository for distribution within their network of local pantries.

The City of Chicago will build upon these past commitments and other projects to make the Resiliency Revitalization Program a success. Success for the WSDA means minimizing its socioeconomic vulnerability alongside its physical vulnerability to flooding. The City will measure success using the metrics outlined in the application and will incorporate these measures into the implementation of its program.

F.c. Direct Financial Commitments. The Resilient Revitalization Program will be enhanced by approximately \$235 million in direct financial commitments for construction and programming from city departments, sister agencies, and regional agencies to build resiliency within the five (5) project areas representing a total program budget of over \$435 million. There are several other projects counted as direct financial commitments. The leveraged project funds include a mix of capital improvements to enhance the transportation system and park facilities or to facilitate development of affordable mixed income housing projects. Adding in these supporting commitments increases the total investment to over \$685 million to increase resiliency in the WSDA.

The City and regional sources have committed \$71 million dollars to the Resiliency Revitalization Program budget. Additionally, Chicago will commit a total of \$21 million to the Resiliency Revitalization Program via 13 DWM projects which are planned or identified in capital programs from 2016 through 2020. An additional \$1 million will be spent toward school

grounds on Space to Grow projects at two CPS schools in the WSDA. Chicago has already committed \$200,000 in DPD funding toward the Resiliency Revitalization Program development, planning and outreach by engaging a consultant team led by AECOM. These funds were used to assist the CRT in developing outreach and application materials, conducting a benefits cost analysis, developing recommendations for the role of GreenCorps in green infrastructure projects, and developing materials that convey the WSDA's identity/heritage as a basis for resiliency. Further, DPD is also committing funds to construct six housing projects through public/private partnerships totaling over \$134 million in three of the five project areas. The housing projects will add a mix of over 500 affordable and market rate dwelling units. Each project will be enhanced with green infrastructure treatments to aid in stormwater management using funds from Chicago's green infrastructure program. Lastly, CDOT is reconstructing Grand Avenue which extends through the WSDA. Nearly half of the project area is located within the Humboldt Park project area. This reconstruction project will improve aesthetics and user safety, enhance bicycle network connectivity, reduce storm flooding incidents in the roadway and control the amount of stormwater entering the sewer system from runoff. The total project cost is \$16 million- \$8 million of which is direct financial commitment and the other \$8 million is supporting commitment.

Additionally, the Chicago Park District is committing funds in four project areas. These projects include building rehabilitation as well as installation of an artificial turf soccer field, new playground equipment and landscaping, and other facility improvements. These capital projects will increase recreational opportunities for residents in the WSDA. Funds for the Resiliency Revitalization Program will be used to improve the performance of these projects to

help manage stormwater more effectively as well as to add trees to increase shade at playground facilities and improve local air quality within the WSDA.

F.c. Supporting Commitments. Supporting commitments for the Resiliency Revitalization Program include sewer reconstruction projects, water main rehabilitation, park facilities rehabilitation, and transit improvements totaling approximately \$250 million.

The City of Chicago, through DWM, will leverage \$27 million in supporting commitments through 17 projects planned in the WSDA. DPD is also committing funds to four (4) public/private partnerships in the WSDA to develop mixed market housing projects in the WSDA. The total investment of both public and private capital is \$99 million, which will add over 250 affordable and market rate dwelling units in the WSDA.

The Chicago Park District is committing additional funds to park facilities in the WSDA. Most recently, La Villita Park was constructed atop a former manufacturing facility in the South Lawndale community. The \$11 million project included environmental remediation of the highly contaminated site to allow for recreational use. The project was engineered to send a majority of its stormwater to a nearby collateral channel. South Lawndale was listed as one of Chicago's most park deficient community areas with a park need of 78 acres to meet the 2 acres/1,000 resident goal. Since La Villita has been opened, that need has been reduced to 56 acres.

The Chicago Transit Authority is committing \$3.6 million for a bus turnaround that will lead to expanded service on one of its more heavily traveled bus lines. The rehabilitation will provide more functional and pleasing accommodations for CTA passengers and will add landscaped areas to improve stormwater management and site aesthetics.

EXHIBIT G: REGIONAL COORDINATION AND LONG-TERM COMMITMENT

Committed actions in Phase I align with the City's Climate Action Plan, which outlines resilience activities through the year 2050. Since the Phase I application submission, through a funding award from the Rockefeller Foundation's 100 Resilient Cities initiative, the City has created a Chief Resilience Officer (CRO) position and posted the vacancy application to begin the selection and hiring process. Once hired, the CRO will join the CRT and incorporate this knowledge and activity as he or she leads the development of a comprehensive resilience strategy for Chicago.

Since the Phase I application, the City has made progress with the Residential Funding Assistance Program (RFAP). The RFAP is a CBDG-DR funded program aims at delivering direct assistance to the most vulnerable households with the most long-term impact and unmet needs from the 2013 flood, which led to a major disaster declaration for Individual Assistance and is the basis for qualification of this application (DR-4116-IL). The City published a request for proposal and subsequently contracted with five community delegate agencies through a competitive bidding process to execute the \$10.3 million program. The Department of Planning and Development, Office of Budget and Management, Office of Emergency Management and Communications, and Department of Public Health hosted a kick off meeting with the awarded delegate agencies, the Federal Emergency Management Agency, the American Red Cross, and the leadership of the Community Organizations Active in Disaster (COAD) Long Term Recovery Committee to develop a strategy for the continuation of the disaster case management and delivery of the direct assistance program. The program focuses on the remaining case files of individuals and households still impacted from the 2013 flood. As a part of the newly developed contract, the COAD's Long Term Recovery Committee transferred the disaster recovery case

files to the contracted delegate agencies. Additionally, the Chicago OEMC submitted a routine use request to FEMA to access and cross-reference the full FEMA dataset from DR-4116 to merge the best available data with the case files. The addition of the FEMA data to the case files from the Long Term Recovery Committee will allow the City to prevent the duplication of benefits and also assist the delegate agency case managers in their interactions with residents.

Importantly, the CDBG-DR Action Plan and substantial amendment HUD authorized the City to provide, not only repair and rebuild assistance to the residents with unaddressed damage and unmet need from the 2013 flood, but also build the residents to resilience by investing in home infrastructure improvements that help reduce the risk of future flooding. As of the time of this application, the Department of Planning and Development has conducted three program and voucher trainings for the contracted delegate agencies and the delegate agencies will begin reaching out to 325 residents to determine scope of repairs needed and start the assistance process.

In October 2013, the City made a five year, \$50 million capital budget commitment to green infrastructure projects. Of that, \$1.5 million is dedicated to the WSDA with the goal of \$5 million at the end of the five-year period (2013 to 2018) with the overall goal to dramatically reduce the risk of basement flooding in the City. The \$50 million capital investment is aligned with the \$63 million in CDBG-DR investment as outlined in the CDBG-DR Action Plan and Substantial Amendment to HUD.

Community engagement and participation in the NDRC planning efforts are both critical components and also key indicators of progress toward resilience. During the Phase I application process, the City utilized AmeriCorps teams to reach 3,250 residents via door-to-door visits conducted in February 2015. Those visits were used to engage WSDA community members in

the City-hosted planning workshops. Since that time, the City deployed a targeted outreach strategy utilizing community organizations and long-time partners of the Department of Planning and Development to conduct five community planning workshops with total participation of over 100 community members since Phase I. The City also sent special invitations to residents within the WSDA who currently have an open case file with the Long Term Recovery Committee from the 2013 flood. Also from Phase I, the American Red Cross utilized the first five community workshops as an engagement opportunity for its Home Preparedness Program. Since those workshops, the Red Cross visited 69 homes with preparedness information and smoke detector installation serving 263 residents in the WSDA. The targeted outreach strategy is allowing the City to plan with some of the most impacted and most vulnerable populations within the WSDA.

On the regional level, the Resilience Partnership has committed to working on advancing resilience in the State of Illinois, regardless of the NDRC award. The Chicago Metropolitan Area for Planning (CMAP) has committed to incorporating climate considerations into local plans. CMAP and DPD are now incorporating resilience goals and projects into the Pilsen-Little Village land use plan that was begun in 2013 and will be completed in 2016, especially for the 4-mile Paseo that connects the two communities. The City is also engaged with CMAP's newly formed Climate Resilience Resource Group, which is examine the role of resilience in the next revision of the Go To 2040 regional comprehensive plan. The Regional Partnership is also engaged in activities at the state level. In 2013, the State of Illinois passed legislation expanding eligibility of funding from the Illinois Clean Water State Revolving Fund (CWSRF) for stormwater and green infrastructure projects. Currently, no CWSRF financing can be used toward green infrastructure and urban stormwater projects, however, the Regional Partnership's goal is to utilize CWSRF as a source of financing these projects.

The City has refined and focused the measurement and monitoring components based on the Draft City of Chicago Resiliency Metrics Framework presented in the Phase I application. The City's measurement plan incorporates a broad range of input from the Rockefeller Resilience Framework, the City's bridges framework, Healthy Chicago 2.0, the Department of Water Management's Stormwater model, and academic literature. Broadly, the metrics framework identifies data sources, units of measure and analysis, and time series benchmarks for social and physical indicators within the HUD benefits categories of economic revitalization, environmental value, resiliency value, and social value as outlined in the chart below:

<i>Variable/Indicator</i>	<i>HUD Benefits Category</i>	<i>Unit of Measure</i>	<i>Time Series Benchmark</i>	<i>Data Source</i>
Economic Revitalization				
Number of Jobs Created	Economic Revitalization	Jobs within WSDA	Yearly	CDOT
Property Value	Economic Revitalization	Average Property Value in Project Area	Yearly	DPD
Resiliency Value				
Percent of Stormwater Runoff	Resiliency Value	Gallons (measured by actual instrumentation)	Yearly (range, mean, and median values)	DWM
Flood Risk Reduction	Resiliency Value	Number of homes at reduced risk	Yearly	DPD
Environmental Value				
Air Quality	Environmental Value	Units of carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone	Yearly (range, mean, and median values)	Array of Things

Social Value				
Social Cohesion	Social Value	Number of permitted community events	Yearly	DCASE, Park District, CDOT
Insurance Adoption	Social Value	Number of NFIP policies purchased	Yearly	FEMA
Preparedness Training	Social Value	Number of individuals trained in disaster preparedness	Yearly	OEMC, CDPH

Baseline measures for each variable will be taken prior to any proposed project interventions. At the regional level, while the proposed projects vary across jurisdictions, data from each variable will be reported to the Regional Resilience Partnership to assess overall progress toward resilience. Lessons learned from each jurisdiction will be shared to examine methods to maximize performance within each Benefits Category.

Exhibit G.a. Lessons Learned: Incorporating lessons learned into the ongoing improvement of the WSDA plans is a key component of the City’s approach. The City has a strong record of utilizing community feedback during the implementation of plans and initiatives. Qualitatively, Aldermanic, community organization, and resident feedback will be incorporated throughout all aspects of implementation. Additionally, time-series data from each of the performance metrics (above) will be collected and analyzed on an ongoing basis. Improvement and progress toward the designated benchmarks will be tracked. The City’s approach also acknowledges that new data sources or performance metrics may emerge as the project matures and such opportunities for new measures of progress will be incorporated as appropriate. As a part of the Citywide approach to Resilience, the Chief Resilience Officer will play a key role in tracking which

projects or project components are most effective and reproducible to other areas of the City. All of the aforementioned input will give the Chicago Resilience Team a comprehensive view of the effectiveness of the approach and inform corrective actions as necessary.

Exhibit G.b. Legislative Action: The City has a strong foundation of progressive policies that promote resilience and sustainability. The City's policies include Complete Streets Chicago, Sustainable Urban Infrastructure Design Guidelines and Policies (2013), Chicago Forward Action Agenda (2012), and CDOT's Placemaking Guidelines.

Exhibit G.c. Raising Standards: The Chicago Department of Transportation meets and exceeds construction standards for green infrastructure investments in the public right-of-way. Additionally, since June of 2005, the Chicago Sustainable Development Policy requires that construction projects exceed local stormwater ordinance standards. The City does not require freeboard above the minimum NFIP requirements, as the flood risks in the WSDA are based on the threat of stormwater and sewer back up. Since June of 2005, the City's Sustainable Development Policy requires green roofs, building certification, and in some cases projects to exceed the local stormwater ordinance requirements.

The projects proposed within this application bring neighborhoods to a higher level of resilience than is otherwise required by regulation. Project interventions include components like green infrastructure and stormwater landscapes that can act as community gardens and gathering places. Also, the proposed plan calls for industrial developers to provide stormwater retention or detention where there is currently no retention or detention capacity. The plan proposes developing stormwater capture at schools in a manner that improves the school grounds for recreation. Distributed throughout the WSDA is a concerted effort to plant thousands of trees.

Exhibit G.d. Resilience Actions Related to Plan Update or Alignment: The City's resilience approach and all associated actions are consistent and aligned with: Complete Streets Chicago, Chicago Forward Action Agenda (2012), Building a New Chicago, CMAP's Go To 2040 comprehensive plan, the FEMA Approved Multi Hazard Mitigation Plan, Draft Chicago Department of Public Health (Public Health Emergency Preparedness) Long Term Recovery Plan, Healthy Chicago 2.0, the FEMA/DHS approved Threat and Hazard Identification Risk Assessment, and the State of Illinois and FEMA Approved Emergency Operations Plan.

City does not have a Citywide land use plan. As a part of the proposed project, the City is going to develop a land use plan in Little Village or North Lawndale which will start with resilience-building process. This proposal and its associated projects were built based on the best available data from Disaster Declaration 4116 and significant input from residents regarding the flooding problems within their communities. FEMA funding eligibility within the City of Chicago is not based on land use, because the residents are flooding due to stormwater and sewer system back up, not overland flooding. FEMA flood plains are located in a very small area of the City outside of the WSDA. As a result, land use matters do not disqualify individuals and households from FEMA Individual Assistance.

The City's approach is congruent with the FEMA Approved Multi-Hazard Mitigation Plan. As discussed in the Soundness of Approach section of this application, the Hazard Mitigation Plan cites and utilizes the following plans and programs to achieve disaster risk reduction: Green infrastructure development (Pages 40-42, 74, 99, and 111 of Volume II of the Hazard Mitigation Plan), MWRD integration in planning, Green Alley Program, and the Climate Action Plan (Appendix D of Volume II of the Hazard Mitigation Plan), and DWM's stormwater management planning (Appendix H of Volume II of the Hazard Mitigation Plan). The plans

embedded within the Hazard Mitigation plan exist to support the overall goal of building resilience.

All of the projects within this proposal are focused on the most impacted and distressed individuals. The City does not have an enhanced multi-hazard mitigation plan; however, as mentioned above, the existing FEMA Approved Multi Hazard Mitigation Plan utilizes an array of City green infrastructure, sustainability, and resilience-building plans as mechanisms to account for climate change. The Plan identifies and highlights the risks of environmental hazards (especially flooding and extreme heat) as priority risks to be addressed.

Exhibit G.e. Resilience Actions Related to Financing and Economic Issues: The Regional Resilience Partnership is aiming to access the Illinois Clean Water State Revolving Fund in order to establish a long-term funding mechanism in the reduction of urban flood risk for areas like the WSDA. In addition, the City has made a five year, \$50 capital budget commitment to green infrastructure projects, with a \$5 million investment for the years 2013 to 2018. Full details for near and long-term financing are outlined in the Leverage section of this proposal.

The WSDA is heavily populated with two- to four-flat buildings, indicating that over half of the population is renting. A residential upgrade program is a significant component of this proposed project implementation with over 7,500 planned upgrades to residential buildings. Additionally, the City's disaster response and recovery plans provide human and social service resources to individuals (especially the most vulnerable individuals) within the context of the Citywide Emergency Operations Plan, Multi Agency Resource Plan, and CDPH Long Term Recovery Plan with associated Disaster Case Management Capacities. Resources provided after a disaster include anything from replacement of government issued photo IDs, to school supplies

for children, food/groceries, financial vouchers for housing/hotels, emotional and spiritual support, and psychological first aid.

A core component of the proposed project is the reduction of flood risk, increase in resilience, and investment in sustainable infrastructure in key commercial corridors in the WSDA. It is anticipated that the reduction of flood risks and support of these commercial areas through sustainable and resilient infrastructure will create an environment conducive to business growth. Education on flood insurance options will be included as a part of the proposed community outreach efforts.

ATTACHMENT D: CONSULTATION SUMMARY

CITY OF CHICAGO

**NATIONAL DISASTER RESILIENCE COMPETITION
PHASE 2 APPLICATION**

October 9, 2015 - DRAFT

Citizen Participation and Consultation Summary Chart

1	2	3	4
<i>Agency Name</i>	<i>Agency Type - Target</i>	<i>Type of Outreach</i>	<i>- Method of Notification (if applicable)</i>
AECOM	Design and Engineering Professionals – N/A	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional
Allstate Insurance	Business/Private Sector – N/A	Industry Expert Meeting	- Prepared questions from regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) for industry experts.
American Red Cross	Civic/Non-Profit Organization – Communities and individuals hit with disaster	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Center for Neighborhood Technology	Civic/Non-Profit Organization – N/A	Expert Review Session; Northeastern Illinois Resilience Partnership Meetings; Calumet Stormwater Collaborative Meeting	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
City of Chicago Mayors Office	Local Government Agency – N/A	Northeastern Illinois Resilience Partnership Meetings; Expert Review Session	- Structure, objectives, and priority actions for long-term regional partnership. - Meeting invitations via direct email
Chicago Department of Planning & Development	Local Government Agency – N/A	Northeastern Illinois Resilience Partnership Meetings	- Structure, objectives, and priority actions for long-term regional partnership.
Chicago Department of Water Management	Local Government Agency – N/A	Northeastern Illinois Resilience Partnership Meetings; Calumet Stormwater Collaborative Meeting	- Structure, objectives, and priority actions for long-term regional partnership. - Meeting invitations via direct email and phone calls.
Chicago Metropolitan Agency for Planning	Metropolitan Planning Organization– N/A	Expert Review Session; Northeastern Illinois Resilience Partnership Meetings; Calumet Stormwater Collaborative Meeting	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Chicago Park District	Civic/Non-Profit Organization – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional

Chicago Wilderness	Civic/Non-Profit Organization – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.
City of Blue Island	Civic/Non-Profit Organization – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.
Cook County Bureau of Community Development	Local Government Agency – N/A	Northeastern Illinois Resilience Partnership Meetings; Calumet Stormwater Collaborative Meeting; Expert Review Session	- Structure, objectives, and priority actions for long-term regional partnership. - Meeting invitations via direct email and phone calls.
Cook County Department of Environmental Control	Local Government Agency – N/A	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional
Cook County Department of Planning and Development	Local Government Agency – N/A	Northeastern Illinois Resilience Partnership Meetings; Expert Review Session	- Structure, objectives, and priority actions for long-term regional partnership. - Meeting invitations via direct email
Cook County Office of Homeland Security & Emergency	Local Government Agency – N/A	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional
Conservation Design Forum	Design and Engineering Professionals – N/A	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional
Delta Institute	Civic/Non-Profit Organization – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.
DuPage County Department of Stormwater Management	Local Government Agency – N/A	Northeastern Illinois Resilience Partnership Meetings; Expert Review Session	- Structure, objectives, and priority actions for long-term regional partnership. - Meeting invitations via direct email
Farr Associates	Design and Engineering Professionals – N/A	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional
FEMA – Region 5	Federal Government Agency – Communities and individuals hit with disaster	Industry Expert Meeting	- Prepared questions from regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) for industry experts. - Meeting invitations via direct email

Forest Preserve District of Cook County	Civic/Non-Profit Organization – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.
Illinois Department of Insurance	State Government Agency – N/A	Industry Expert Meeting	- Prepared questions from regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) for industry experts
Illinois Department of Natural Resources	State Government Agency – N/A	Expert Review Session; Northeastern Illinois Resilience Partnership Meetings; Calumet Stormwater Collaborative Meeting	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Illinois Environmental Protection Agency	State Government Agency – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.
Illinois-Indiana Sea Grant	Research Institution – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.
Geosyntec Consultants	Design and Engineering Professionals – N/A	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Metropolitan Mayors Caucus	Civic/Non-Profit Organization – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.
Metropolitan Planning Council	Civic/Non-Profit Organization – N/A	Expert Review Session; Calumet Stormwater Collaborative Meeting; Northeastern Illinois Resilience Partnership Meetings	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Metropolitan Water Reclamation District of Greater Cook County	Civic/Non-Profit Organization – N/A	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Natural Resource Defense Council	Civic/Non-Profit Organization – N/A	Expert Review Session & Northeastern Illinois Resilience Partnership Meetings	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
North Central Illinois Council of Governments	Civic/Non-Profit Organization – N/A	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.

OAI, Inc.	Economic/Workforce/Community Development Organization – Vulnerable, difficult to employ populations	Calumet Stormwater Collaborative Meeting	<ul style="list-style-type: none"> - Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions. - Meeting invitations via direct email.
Openlands	Civic/Non-Profit Organization – N/A	Expert Review Session; Calumet Stormwater Collaborative Meeting	<ul style="list-style-type: none"> - Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Pepper Construction Company	Business/Private Sector – N/A	Expert Review Session	<ul style="list-style-type: none"> - Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions. - Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Terry Guen Design Associates	Design and Engineering Professionals – N/A	Expert Review Session	<ul style="list-style-type: none"> - Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Skidmore, Owings & Merrill	Design and Engineering Professionals – N/A	Expert Review Session	<ul style="list-style-type: none"> - Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
South Suburban Mayors and Managers Association	Civic/Non-Profit Organization – N/A	Calumet Stormwater Collaborative Meeting	<ul style="list-style-type: none"> - Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.
Stanhope Consulting	Business/Private Sector – N/A	Expert Review Session	<ul style="list-style-type: none"> - Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
UI Labs	Research Institution – N/A	Expert Review Session	<ul style="list-style-type: none"> - Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
Building Resilience Against Climate Effects, University of Illinois at Chicago	Research Institution – N/A	Expert Review Session	<ul style="list-style-type: none"> - Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional experts.
US Army Corps of Engineers	Federal Government Agency – N/A	Calumet Stormwater Collaborative Meeting	<ul style="list-style-type: none"> - Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.
US Environmental Protection Agency – Region 5	Federal Government Agency – N/A	Calumet Stormwater Collaborative Meeting	<ul style="list-style-type: none"> - Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional actions.

US Green Buildings Council – Illinois Chapter	Design and Engineering Professionals – N/A	Expert Review Session	- Regional applicants (City of Chicago, Cook County, DuPage County, State of Illinois) presented on respective needs and approaches to solicit input, ideas, and feedback from regional
Village of Homewood	Local Government – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional
Village of Midlothian	Local Government – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional
Village of Park Forest	Local Government – N/A	Calumet Stormwater Collaborative Meeting	- Invited input on regional priorities for collaborative actions at Calumet Stormwater Collaborative meeting, presented a matrix of potential regional

Community Outreach during Phase II

The City of Chicago received input from a broad spectrum of community stakeholders including residents, commercial and industrial businesses, community-based non-profits, City of Chicago Delegate Agencies, schools and active neighborhood groups. Input was received and integrated into the City's program development as described below:

- Immediately after the Phase I application was submitted DPD staff began meeting with stakeholders in each community area to identify priority areas of need and where investment in resilience could enhance existing program and planning efforts, investment and community activity. During this phase of outreach, 45 community organizations, which included over 100 residents and business owners, were consulted between May and September 2015. More targeted meetings with manufacturers located in the industrial corridors within the WSDA were held to discuss opportunities for constructing GI in under-used areas or undeveloped land within the corridors.
- Based on feedback from these meetings projects areas were delineated within each community area using a land use map identifying areas and calculating acreage where green infrastructure could be constructed within each of the land use types; (1) residential, (2) commercial and industrial and (3) parks and boulevards.
- Beginning in August DPD began working with consultants to model how much stormwater could be diverted from the City's combined sewer system by applying the green infrastructure project types within each land use type within each project area.
- In September, five workshops were held to present an overview of resiliency planning, what green infrastructure is and the many benefits associated with them, illustrations of how they could be applied to the various land use types and the proposed project areas within each community area. Nearly 500 residents that have been identified by the City as having backyard gardens and roughly 250 participants in the City's Large Lot Program were mailed or emailed a double-sided (English/Spanish) flyer announcing the workshop dates and locations. Students participating in the Garfield Park Community Council Green Team also canvassed several hundred homes in the Garfield neighborhoods. Multi-lingual facilitators were present at every workshop. During the workshops valuable input was received from residents and businesses further identifying areas where flooding occurs and where cultural and historical assets could be protected and enhanced with investments in resilience measures.
- Based on the input from the five workshops project area boundaries and placement and size of project types were adjusted. This data was applied to the modeling of the amount of stormwater that could be diverted in each project area and the impact it would have on basement flooding risks to structures in the project areas. It was also used to complete the program's benefit and cost analysis.

Workshop Flyer

CHICAGO RESILIENCE | [engage](#), [build](#), [recover](#)

Greening Your Neighborhood







HELP GREEN YOUR NEIGHBORHOOD AND REDUCE FLOODING

Please attend a community workshop in your area to discuss how greening your community can help your neighborhood recover from incidents of extreme weather, reduce damage to private property and provide additional quality of life improvements.

Community Workshops

EAST + WEST	HUMBOLDT PARK	LITTLE VILLAGE	NORTH LAWDALE	AUSTIN
GARFIELD PARK WED. SEPT. 9 5:00 - 7:00PM Garfield Community Center 3001 N. Central Park Ave.	TUES. SEPT. 15 6:00 - 8:00PM Nia Family Center 744 N. Monticello Ave.	THURS. SEPT. 17 5:00 - 7:00PM Madison Middle School 3000 W. 28th St.	MON. SEPT. 21 5:00 - 7:00PM Lamont Middle School Health Center Fireplace Loft 3824 W. Ogden	TUES. SEPT. 22 5:00 - 7:00PM Austin Town Hall Park 5610 W. Lake St.

What are Your Priorities? We want to know.

HOSTED BY:
Office of Mayor Robin E. Enos
Department of Planning and Development
Department of Water Management
Department of Transportation
Department of Public Health
Office of Emergency Management and Communications

CHICAGO RESILIENCE | [engage](#), [build](#), [recover](#)

Enverdezca su vecindario

AYUDE A ENVERDEZCAR SU VECINDARIO Y REDUZCA INUNDACIONES

Asista a una junta comunitaria sobre cómo el enverdecer su comunidad puede ayudarla a recuperarse de eventos como clima extremo, también aprenda a cómo reducir el daño a la propiedad privada y cómo proveer mejoras para la calidad de vida en el área.

Talleres Comunitarios

EAST + WEST	HUMBOLDT PARK	LITTLE VILLAGE	NORTH LAWDALE	AUSTIN
GARFIELD PARK MIÉRCOLES, SEPT. 9 5:00 - 7:00PM Garfield Community Center 3001 N. Central Park Ave.	MARTES, SEPT. 15 6:00 - 8:00PM Nia Family Center 744 N. Monticello Ave.	JUEVES, SEPT. 17 5:00 - 7:00PM Madison Middle School 3000 W. 28th St.	LUNES, SEPT. 21 5:00 - 7:00PM Lamont Middle School Health Center Fireplace Loft 3824 W. Ogden	MARTES, SEPT. 22 5:00 - 7:00PM Austin Town Hall Park 5610 W. Lake St.

¿Cuáles son sus prioridades? Queremos saber.








PRESENADO POR:
Office of Mayor Robin E. Enos
Department of Planning and Development
Department of Water Management
Department of Transportation
Department of Public Health
Office of Emergency Management and Communications

Workshop Posters

CHICAGO RESURGE | [engage](#), [build](#), [measure](#)

WELCOME

**EAST AND WEST GARFIELD PARK
NEIGHBORHOOD WORKSHOP 5PM - 7PM**



East and West Garfield Park neighborhoods present a focus area

What is Driving This Project?

The City of Chicago is hosting a series of community workshops to discuss how greening your community can help your neighborhood recover from incidents of extreme weather, reduce damage to private property and provide additional quality of life improvements.



STORMWATER MANAGEMENT + GREEN INFRASTRUCTURE IS PART OF THE SOLUTION


HOSTED BY:
Office of Mayor Rahm Emanuel
Department of Planning and Development
Department of Water Management
Department of Transportation
Department of Public Health
Office of Emergency Management and Communications

CHICAGO RESURGE | [engage](#), [build](#), [measure](#)

Green Infrastructure Improvements


"Green" solutions, also called "green infrastructure" projects, are a stormwater management tool that reduces the burden on the City's grey infrastructure. Green infrastructure can help manage and treat stormwater on-site before it enters the combined sewer system and helps reduce the likelihood of flooding. These projects also provide livable city benefits like neighborhood beautification and traffic calming.

Examples of GREEN infrastructure improvements include:




Permeable Pavement

Permeable paving allows stormwater to soak into the ground in contrast to hard surfaces (concrete or asphalt) where stormwater rapidly flows into the sewer system. Planning Tip: Best used in alleys, parking spaces, and sidewalks.




Bulb Out

Bulb Outs are a traffic calming method that extends the sidewalk, reducing the distance to cross the street and increasing pedestrian visibility and safety. These can also include various green technologies to capture and treat stormwater. Planning Tip: Implement along streets and at intersections.



Rain Gardens

Rain Gardens capture stormwater that runs off streets, roofs, and parking lots. Plants and soil absorb that water, reducing the amount of runoff entering our sewer system. Planning Tip: Best along sidewalks (by streets) or bulb-outs. You can also disconnect your downspout, and run your rainwater to a rain garden in your backyard.




Rainwater Harvesting

Rainwater harvesting collects and diverts stormwater from hard surfaces such as roofs that would otherwise be going into the combined sewer system, making it available for use. Planning Tip: Best for buildings and other structures with large, relatively clean, rainwater catchment areas - such as roofs - and sufficient space for above or below ground cisterns.

HOSTED BY:
Office of Mayor Rahm Emanuel
Department of Planning and Development
Department of Water Management
Department of Transportation
Department of Public Health
Office of Emergency Management and Communications

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TYPICAL NEIGHBORHOOD CHARACTER


How Should This Neighborhood Street "Look and Feel"?

Select images that you consider the **MOST** and **LEAST** appropriate "Look and Feel".


PLANTINGS



PAVING & EDGE TREATMENTS




BULBOUTS



HOSTED BY:
Office of Mayor Rahm Emanuel
Department of Planning and Development
Department of Water Management
Department of Transportation
Department of Public Health
Office of Emergency Management and Communications

CHICAGO RESURGE | [engage](#), [build](#), [measure](#)




TYPICAL COMMERCIAL CHARACTER


How Should This Commercial Street "Look and Feel"?

Select images that you consider the **MOST** and **LEAST** appropriate "Look and Feel".


TREES & LANDSCAPE



COMMUNITY SPACES / PEDESTRIAN IMPROVEMENTS



PAVING / PARKING / TRAFFIC CALMING / BICYCLE IMPROVEMENTS



HOSTED BY:
Office of Mayor Rahm Emanuel
Department of Planning and Development
Department of Water Management
Department of Transportation
Department of Public Health
Office of Emergency Management and Communications



TYPICAL INDUSTRIAL CHARACTER

How Should This Industrial Street "Look and Feel"?

Select images that you consider the **MOST** and **LEAST** appropriate "Look and Feel".

BUFFERS & EDGES



LARGE SCALE OPPORTUNITIES



GREEN ROOFS / RAIN HARVEST / PARKING LOTS



TYPICAL PARK CHARACTER

How Should This Park + Boulevard "Look and Feel"?

Select images that you consider the **MOST** and **LEAST** appropriate "Look and Feel".

LANDSCAPES / AESTHETIC AND FUNCTIONAL



ACTIVE AREAS AND PASSIVE AREAS



BOULEVARDS / STORMWATER PARK



What is Important to You on This Street?

Select the **top three** additional components that you consider **MOST IMPORTANT**.



COMMUNITY SPACES

Create areas on the street for small gatherings, seating, and public art.

SIDEWALK AMENITIES

Provide additional amenities such as bike racks or benches.

NATURE SPACE

Provide planted areas on the street.



ON-STREET PARKING

On-street parking along the project site.

BICYCLE IMPROVEMENTS

Provide facilities to improve cyclist safety and convenience.

TRAFFIC CALMING & PEDESTRIAN IMPROVEMENTS

Provide facilities to improve pedestrian safety and convenience.



Get Involved!

There are things you can do to reduce your risk of flooding and help reduce the amount of stormwater going into the sewer system.

Become Flood Resilient and Help Build Green Infrastructure Projects Near You!

Join the City of Chicago as we plan, design, and build Green Infrastructure and resilience projects in the city:
www.cityofchicago.org/resilience



Space to Grow

Help transform Chicago schoolyards into vibrant green space and active spaces with the Healthy Schools Campaign and Openlands.
<http://www.healthyschoolscampaign.org>



Get RainReady at Home

Learn how to capture and reuse your rainwater at home for irrigation and help keep stormwater out of the combined sewer system.
<http://rainready.org>



Save Water and Save Money

Reducing water usage helps reduce the risk of flooding by limiting the amount of water that flows into the sewer system. Join the Department of Water Management to install a water meter to keep track of your water usage.
<http://www.metersave.org>



Chicago Conservation Corps

Join a crew to help maintain and install environmental education and service projects throughout the city.
<http://chicagoconservationcorps.org>

Connect with the City of Chicago to help improve local resilience.
resilience@cityofchicago.org www.cityofchicago.org/resilience

@SustainChicago




Workshop Powerpoint Presentation

In February

We discussed generally where there are problems with flooding and heat in your neighborhood and ideas for how to address these issues

Tonight

We want to discuss more specifically methods for addressing flooding and extreme weather and where in your neighborhood they could be applied



SAVE THE DATES

Weather Resilience Workshops

The Northeast Illinois Resilience Partnership is holding a series of neighborhood workshops to address the region's resilience to incidents of extreme weather, especially storms that cause floods and related damage. The purpose of the workshops is to identify techniques and infrastructure improvements that foster sustainability and reduce damage to private and public property.

Please attend to share ideas and concerns about the sustainability of your home, business, and neighborhood. Refreshments will be provided.

Meetings will be held from 6 to 8 p.m.

Monday, Feb. 8	Tuesday, Feb. 16	Wednesday, Feb. 16	Thursday, Feb. 17	Friday, Feb. 18
North Loop Park 2015 N. Lake St. Chicago	South Loop Park 2015 S. Lake St. Chicago	West Loop Park 2015 W. Lake St. Chicago	East Loop Park 2015 E. Lake St. Chicago	Central Loop Park 2015 Central Loop Chicago



Greening Your Neighborhood

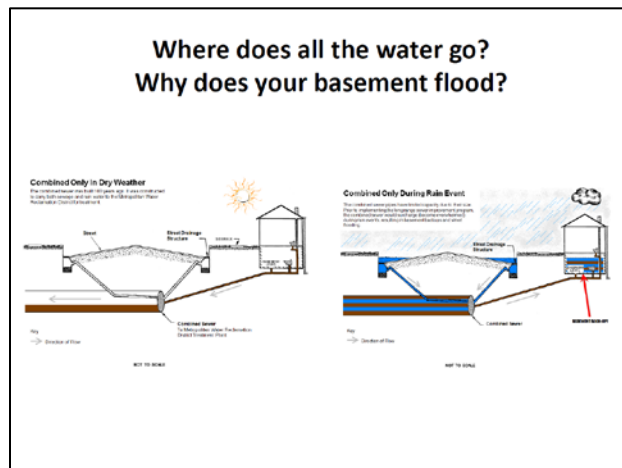
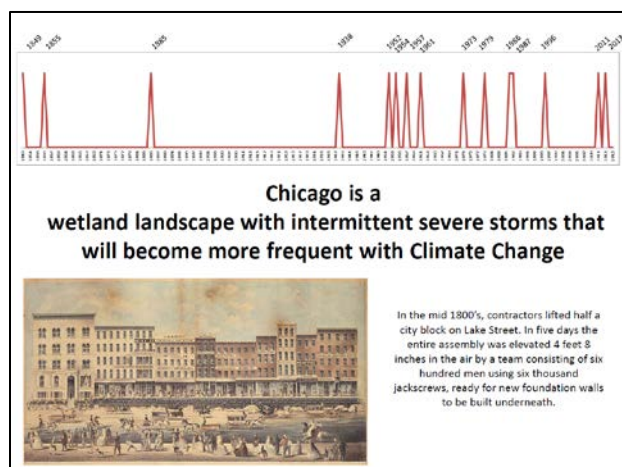
Learn about the benefits of green infrastructure and how it can be used to address flooding and extreme weather. This workshop will focus on identifying opportunities for green infrastructure in your neighborhood and how it can be used to address flooding and extreme weather.

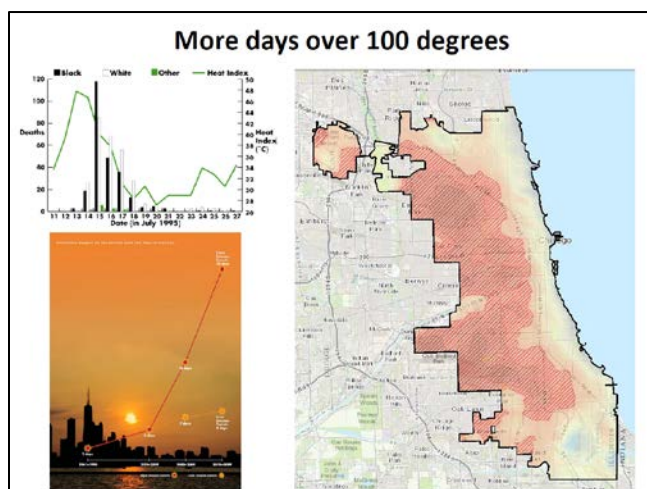
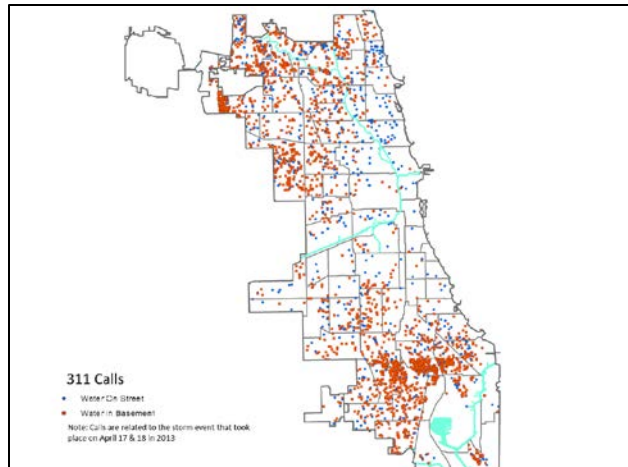
Community Workshops

Location	Time	Topic	Facilitator
North Loop Park	6:00 - 8:00 p.m.	Green Infrastructure	John Doe
South Loop Park	6:00 - 8:00 p.m.	Green Infrastructure	John Doe
West Loop Park	6:00 - 8:00 p.m.	Green Infrastructure	John Doe
East Loop Park	6:00 - 8:00 p.m.	Green Infrastructure	John Doe
Central Loop Park	6:00 - 8:00 p.m.	Green Infrastructure	John Doe

What are Your Priorities? We want to know!

Identify the most pressing issues in your neighborhood and how they can be addressed. This workshop will focus on identifying opportunities for green infrastructure in your neighborhood and how it can be used to address flooding and extreme weather.





Grey and Green Solutions

Grey Infrastructure Improvements

"Grey" solutions, such as larger sewer pipes or upgraded pump stations, can improve the sewer system by providing additional capacity to store and convey wastewater. Replacing existing and constructing new grey infrastructure will upgrade our aging infrastructure to provide a reliable, sustainable, and resilient system now and for generations to come.

Examples of GREY infrastructure improvements include:

Pump Station Repairs

Upgrading and repairing our pump stations helps to ensure that the combined sewer system continues to operate reliably and efficiently.

Pipe Replacement

Many of our 4,400 miles of sewer pipes are over 100 years old. New and larger pipes provide more capacity to store and convey wastewater.

Sewer Main Repairs

The Metropolitan Water Reclamation District of Greater Chicago (MRD) operates the largest and most advanced treatment plant for Chicago. Each County, and surrounding counties, provide 1.4 billion gallons of wastewater each day through 17 wastewater treatment plants.

Green Infrastructure Improvements

"Green" solutions, also called "green infrastructure" projects, are a stormwater management tool that reduces the burden on the City's grey infrastructure. Green infrastructure can help manage and treat stormwater on-site before it enters the combined sewer system and helps reduce the likelihood of flooding. Green projects also provide valuable benefits like neighborhood beautification and traffic calming.

Examples of GREEN infrastructure improvements include:

Permeable Pavement

Permeable paving allows water to soak into the ground or collect in a rain garden, decreasing or delaying stormwater runoff into the sewer system. Permeable Pavement can be used in parking lots, streets, and sidewalks.

Rain Gardens

Rain gardens capture stormwater that runs off roofs, yards, and parking lots. Plants and soil absorb the water, reducing the amount of water entering our sewer system. Rain gardens also provide aesthetic benefits, improve air quality, and are a great addition to a front yard or back garden.

Rain Barrels

Rain barrels are a simple, cost-effective method that captures rain water, reducing the amount of water that enters the sewer system. Rain barrels can be used in parking lots, streets, and sidewalks.

Rainwater Harvesting

Rainwater harvesting captures and stores rainwater from roofs, which can be used to water lawns, gardens, and other outdoor spaces. Rainwater harvesting is a simple, cost-effective method that captures rain water, reducing the amount of water that enters the sewer system. Rainwater harvesting can be used in parking lots, streets, and sidewalks.

Green provides multiple benefits



Environmental

- Lower urban temperatures
- Less basement flooding



Social

- Neighborhood pride and cohesion
- Safer streets



Economic Development

- Jobs

Greencorps Chicago

- A program of the City of Chicago Department of Transportation in partnership with WRD Environmental.
- Launched in 1994
- Green-industry job training for individuals with barriers to employment
- Supports the City's & Partners' environmental projects



WE OFFER

- ✓ Individualized services to help reduce flood risks
- ✓ Affordable and scalable solutions backed by solid research and analysis
- ✓ Award-winning outreach programs
- ✓ Guidance with financing
- ✓ Training courses and workshops for homeowners and municipal leaders alike

WE PROVIDE

TALKS, TRAINING,
AND TECHNICAL
ASSISTANCE

Humboldt Park LISC Plan

Where to hold & harvest stormwater

Neighborhoods

- Front and backyards and parkways
- School grounds and small parks
- Community routes

Commercial and Industrial Corridors

- Commercial Corridors
- Industrial Parks

Regional Parks and Boulevards

- Historic Boulevards
- Parks

Ideas for neighborhoods



The top-left photograph shows a stone walkway leading through a lush green area with trees and a blue car parked on the right. The top-right photograph shows a curved sidewalk with a flower bed containing pink flowers and green plants. The bottom-left photograph shows a water feature with a fountain and a small bridge over a stream, with a brick house in the background. The bottom-right photograph shows two green water barrels next to a white building.

Ideas for Schools



Donald L. Merrill Math & Science School
6011 S Rockwell (Chicago Lawn)

Ideas for Commercial Corridors



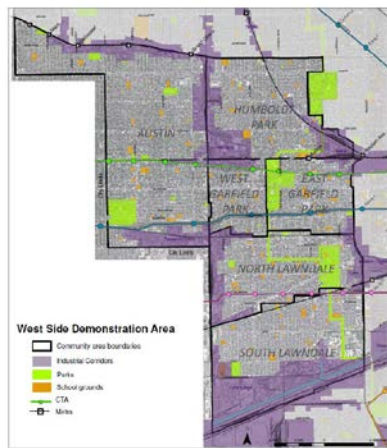
Ideas for Industrial Corridors



Ideas for Parks and Boulevards



16



17

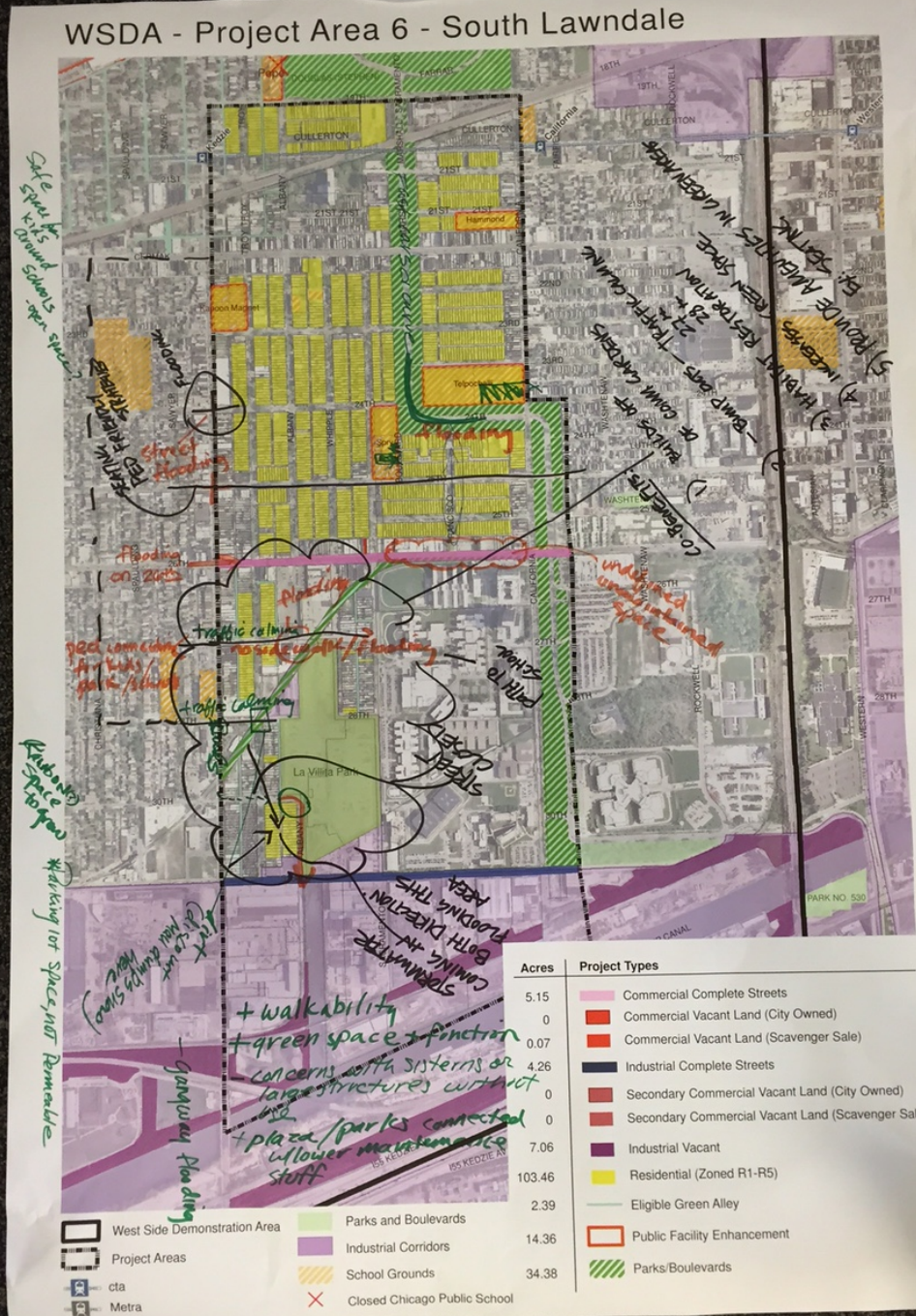
WSDA - Project Area 2 - Humboldt Park



18

Photos from the North Lawndale and Garfield Park workshops



[illegible]

ATTACHMENT F: BENEFIT-COST ANALYSIS

CITY OF CHICAGO

**NATIONAL DISASTER RESILIENCE COMPETITION
PHASE 2 APPLICATION**

October 9, 2015 - DRAFT

Attachment F: Benefit-Cost Analysis and Context for Analysis

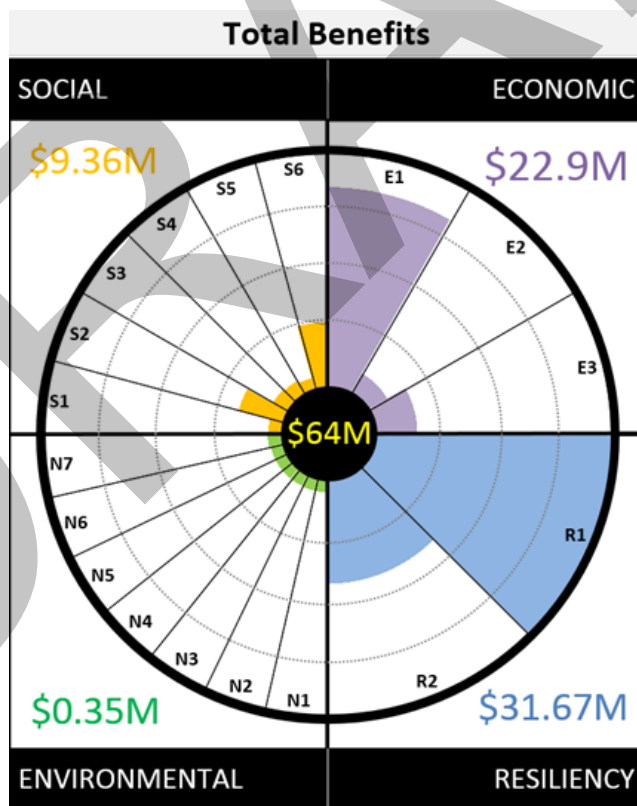
1. Executive Summary	3
A. BCA Preparation Process.....	4
B. Full Proposal Cost.....	4
2. Current Situation.....	6
A. Problem to Be Solved	6
B. Risks and Vulnerabilities	6
C. Social Conditions/Challenges	7
D. Environmental Conditions	7
E. Trends Affecting Disaster Recovery or Vulnerability	10
3. Proposed Project	11
A. Proposal Objectives	11
B. Design Philosophy	11
C. Geographical Boundaries of Project	11
D. Main Components of Proposal Plan.....	12
E. Impact of Anticipated Policy Changes.....	13
F. Timeline for Completion.....	14
G. Estimated Useful Life of the Proposal	14
H. Alternative Discount Rates	14
4. Risks if Not Implemented	15
A. Impact by Timeframe.....	15

B.	Impact on Community	16
C.	Missed Additive Impacts or Benefits.....	16
D.	Area of Poverty Remaining Adversely Affected	16
E.	Costs Avoided.....	16
5.	Benefits and Costs.....	17
A.	Approach to Sources and Analysis	17
B.	Table Summarizing Benefits.....	20
C.	Summary and Quantitative Methodology	26
D.	Summary of Benefits or Costs that Are Difficult to Quantify	44
6.	Risks to Ongoing Benefits	47
A.	Key Risks	47
B.	Uncertainty Analysis.....	47
7.	Assessment of Implementation Challenges	48
A.	Potential Risks to Schedule and Mitigation of Risks.....	48
B.	Community Support.....	49
8.	Sources.....	50

1. Executive Summary

The City of Chicago evaluated a number of alternatives before arriving at the set of projects submitted in this proposal. The analysis informed the set of projects that would yield the highest social, environmental, and economic benefit to the West Side Demonstration Area in consideration of the resources available. This proposal describes the City's final assessment of the qualitative and quantitative benefits for each Project Area. The quantitative benefits across project areas achieve a Benefit Cost Ratio of approximately 2.0; their distribution is shown in Figure 1. As noted below, the monetized benefits are most realized in resiliency where the program will achieve approximately \$32 million a year and \$23 million in economic revitalization benefits.

Figure 1: Total Benefits



SOCIAL		ECONOMIC REVITALIZATION	
S1	Aesthetic	E1	Retail Sales
S2	Recreation	E2	Property Values
S3	Health	E3	Maintenance Jobs
S4	Mobility		
S5	Decreased Auto Use		
S6	Safety		
ENVIRONMENTAL		RESILIENCE	
N1	Stormwater Runoff	R1	Property Damage
N2	Water Savings	R2	Sewer
N3	Air Quality		
N4	Nutrient Pollution		
N5	Ecosystem and Biodiversity		
N6	Temperature		
N7	Energy Use		

A. BCA Preparation Process

An inter-disciplinary, inter-departmental team of City of Chicago staff—including representatives from the Mayor’s Office, Department of Planning and Development, Department of Public Health, Department of Water Management, Department of Transportation, and the Chicago Park District—collaborated in conceiving, assessing, and verifying the consolidated Benefit Cost Analysis (BCA) response.

During this process the City procured AECOM’s Sustainable Infrastructure and Economics groups to develop customized stormwater management and economic models to assess the costs and benefits based on the solutions described in the proposal. City of Chicago staff consulted frequently with AECOM, overseeing the Benefit Cost Analysis (BCA) and developing most of the non-quantitative content of this Appendix. A key element was the analysis of a Hydraulic and Hydrologic model prepared by CH2M for the City’s Department of Water Management. City staff from multiple departments reviewed preliminary quantitative findings and recommended modifications to prevent over-representation of benefits.

B. Full Proposal Cost

The total capital cost of the application is \$269,879,000, with \$200,000,000 requested from HUD, \$70,775,000 from the City of Chicago and other partners.

The capital work will include green infrastructure improvements. For purposes of the Cost Benefit Analysis a projected distribution of these expenses has been made by land use types, each of which with its own mix of technologies. See Section 3 for further details.

Operation and Maintenance Costs are projected to average approximately \$4,000,000 per year over the life of the project, most of which will be borne by the City of Chicago (in constant dollars).

In addition, this will leverage approximately \$169,730,000 of functionally and geographically related projects, which are detailed in Attachment B of this application.

Table 1: Summary of Benefits and Costs

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6	Total
Maintenance Costs	\$932,000	\$1,017,000	\$877,000	\$762,000	\$411,400	\$3,999,400
Capital Cost	\$72,238,262	\$73,078,772	\$71,676,529	\$49,936,777	\$32,367,000	\$299,297,339
Net Present Value	\$60,125,173	\$37,846,740	\$34,750,363	\$74,755,710	\$50,105,159	\$258,139,816
Benefit Cost Ratio	2.0	1.6	1.6	2.8	2.9	2.0
Internal Rate of Return	14%	11%	11%	19%	19%	14%
Return on Investment	166%	137%	132%	234%	237%	170%

2. Current Situation

A. Problem to Be Solved

As described in the City's Phase I application, the April 17 and 18, 2013 severe storms in Chicago produced almost two months of typical rainfall during a single 24-hour period. The excessive rainfall could not flow fast enough through the City's sewer system to a wastewater treatment plant or a combined sewer outfall.

As sewer water rose above drain openings, water backed up into homes, businesses and other buildings causing extensive flooding throughout the City. Some business experienced flooding that affected inventory and others had to temporarily shut down. The city received 2,500 "water in basement" calls and over 800 "water in street" calls from residents in its 50 wards, while Chicago Transit Authority (CTA) received calls about flooding at stations and viaduct locations. On April 18, Governor Pat Quinn declared Cook County and 37 other counties State Disaster Areas. On May 10, FEMA issued a Presidential Disaster Area declaration.

Therefore, this application seeks to improve the ability of infrastructure to detain rainfall and thereby reduce flow volumes and rates to the combined sewer system. During intense rainfall events such as the April 2013 storm, this would reduce the amount and severity of flooding that would occur.

B. Risks and Vulnerabilities

Climate change calculations show that, in the coming years, Chicago can expect two to three times the number of heavy precipitation events and two-to-six times the number of 100 degree days. For example, the city has had four "ten year storms" in the past six years. Chicago may experience average temperatures 4.4 to 4.7 degrees warmer and an additional 5 to 10 days over 95 degrees by mid-century.

C. Social Conditions/Challenges

Flooding disproportionately impacts those that live in poverty, and the elderly. Chicagoans with higher incomes that live in homes with higher property values can better prepare for and respond to flooding and more often have resources to purchase private insurance, maintain their property, retrofit their plumbing systems, or afford post-storm clean up. Single-family homeowners with higher incomes also typically don't have their main living spaces in the basement. In contrast, many renters or crowded households, which are more often low-income, have their main living and sleeping spaces in the basement, and a flood will displace these residents. Elderly residents are disproportionately impacted by flooding since they have accessibility challenges and less physical ability to clean up after floods.

Chicago's proposal for this resilience competition seeks solutions for flooding that can serve as models across the city and throughout the region, but the City is strategically focusing initial investments under this proposal on those who are most vulnerable by targeting investment in the West Side Demonstration Area (WSDA), an area characterized by the highest rates of poverty and economic hardship.

Table 2: Socio-Demographic Profile of West Side Demonstration Area and Chicago as a Whole

Demographics	North Lawndale	South Lawndale	East Garfield Park	West Garfield Park	Austin	WSDA Average	Chicago
Median HH income	\$24,315	\$39,817	\$25,592	\$24,447	\$31,460	\$29,126	\$47,099
Per-capita income	\$12,548	\$10,697	\$13,596	\$10,951	\$15,920	\$12,742	\$27,148
No high school diploma	30.4%	58.7%	26.2%	26.2%	25.0%	33.3%	20.6%
Households below poverty level	38.6%	28.1%	39.7%	40.3%	27.0%	34.7%	18.7%
Unemployed	18.5%	11.5%	16.4%	25.2%	21.0%	18.5%	11.1%

D. Environmental Conditions

Air Quality: Northeastern Illinois does not attain national ambient air quality standards for certain pollutants. It is classified as a marginal non-attainment area for the 8-hour ozone standard, and a non-attainment area for the annual fine particulate matter (PM_{2.5}) standard. The region continues to implement a transportation program which will help to reduce levels of these pollutants to national

standards. However, Illinois EPA reports, that 10-year air quality trends continue to show progress and improvements in overall air quality.

Drinking Water: The City's Department of Water Management provides almost one billion gallons of water a day to Chicago and neighboring suburban communities. Raw water is drawn from cribs about 2-miles out into Lake Michigan and sent to two purification plants, where the water is treated and impurities removed, it then flows by gravity to 12 pumping stations strategically located throughout Chicago for delivery. City laboratories test water quality 24-hours a day 365-days a year. Water supplied by the Department of Water Management exceeds existing and proposed water quality standards established by the United States Environmental Protection Agency and the Illinois Pollution Control Board.

Stormwater Management Networks: The City's Department of Water Management is responsible for removing wastewater and storm runoff from the streets of Chicago through the sewer system, and delivering the effluent for treatment to the Metropolitan Water Reclamation District of Greater Chicago. The City is accelerating replacement of the oldest of the 4,400 miles of sewer main in Chicago. However, as documented in this application, high rates of storm runoff during the heaviest rains cause basement flooding and resultant damage to property. The infrastructure proposed as part of this application joins other efforts such as catch basin flow restrictors that briefly detain storm water in the public way, and a Basement Flooding Partnership that offers homeowners guidance on private improvements to reduce runoff surges from rooftops and other sources.

Wastewater Treatment: The Metropolitan Water Reclamation District serves more than five million residents of Cook County. Wastewater is delivered through sewer systems to one of MWRD's seven treatment plants. Approximately 467 billion gallons were treated at the District plants during 2014. These plants have been very successful in meeting the National Pollutant and Discharge Elimination System permit limits that protect and enhance the quality of our waterways.

Soils: As an urbanized area with a history of industrial employment, discovery of sites with Underground Storage Tanks or other soil contamination can occur. The City works with construction companies, the

Illinois EPA, and USEPA to assure that when contamination is discovered, remediation and disposal of contaminated materials are done in a manner that meets or exceeds all relevant standards and safety guidelines. One remediated site in the WSDA, a former Celotex plant, was recently opened to public use as La Villita Park.

However, soil conditions are not a risk to drinking water. The Chicago City Council passed a groundwater ordinance in 1997 prohibiting the installation of new potable water supply wells to limit the potential for persons to be exposed to potential contaminants by ingesting groundwater. Since new potable wells are prohibited, groundwater contamination is not a potential source of exposure for the vast majority of sites in the city.

Limiting the potential exposure pathways posed to workers by ingesting or inhaling soil makes cleanups more practical and cost effective. Site owners enrolled in the Illinois Site Remediation Program must still test and evaluate groundwater impacts from their site; however, the City of Chicago and the Illinois EPA have a memorandum of understanding which acknowledges the City's groundwater ordinance as an acceptable "institutional control" under the state's Tiered Approach to Corrective Action Objectives (TACO) guidelines, limiting the need for groundwater remediation.

Land Use and Habitat: In Chicago, industrial land use has been oriented to the railroads, waterways, and later highways - that provided raw goods and delivered completed products. The City has orderly street grid (deriving from the historic federal Northwest Ordinance) with commercial and major public facilities focused on arterial streets every half-mile, while residences and smaller public facilities filling in local streets 1/8 or 1/16 of a mile apart.

Another key land use feature derives from the 1909 Burnham Plan of Chicago: an "emerald necklace" of wide, grassy Boulevards that link a series interconnect regional parks. Several of these boulevards and

three of these regional parks (Humboldt, Garfield, and Douglas) are part of the WSDA and are sites for some of the green infrastructure improvements proposed as part of the application.

Habitat: Cities can be hostile places for wildlife. However, with proper management, urban areas can house a number of important wildlife species, including carnivores, small mammals, birds, insects, reptiles and amphibians.

To assess the biodiversity of the greater Chicagoland area, Lincoln Park Zoo's Urban Wildlife Institute has established monitoring stations within city parks, forest preserves, golf courses and cemeteries across a four-county area including Chicago. Motion-triggered cameras are deployed four times per year at more than 100 sites to determine which species are present and to assess spatial and long-term patterns in wildlife communities. To date, the motion-triggered cameras have mainly detected medium- to large-sized mammals and some birds. In 2012, researchers also began opportunistically sampling arthropods (insects, spiders, etc.) found within the metal security cases that house the motion-triggered cameras.

E. Trends Affecting Disaster Recovery or Vulnerability

Many of the neighborhoods most at risk from flooding, such as those in the WSDA, are also those that suffer from population loss and high levels of vacancy. While many factors contribute to depopulation, basement flooding can be a tipping point event for residents, triggering them to leave their community and move out of the city. This has significant consequences for social stability and the economic prosperity of Chicago's neighborhoods. Further, solutions that reduce flood risk, particularly green stormwater infrastructure and home retrofits, can boast economic development and community revitalization by generating jobs and new workforce development opportunities, enhancing property values, and addressing other environmental challenges such as urban heat island effect.

3. Proposed Project

A. Proposal Objectives

As detailed in the full application, the key objective of the proposal is to reduce the volume and rate of stormwater flow that enters the combined sewer system. When successful, basement flooding and related property damage that can occur during high volume storms can be reduced. The City and its partners also intend for some or all of the solutions to have additional benefits including economic development, community cohesion, traffic safety, and public health.

These infrastructure improvements will be distributed across six community areas on the West Side of Chicago. For the purposes of this cost-benefit analysis, benefits are reported primarily by community area (with two communities analyzed as one unit) to assure that each community will receive benefit.

B. Design Philosophy

The general design philosophy is to distribute the construction of various types of green infrastructure technologies on both public and private properties to capture stormwater and either infiltrate it into soil or retain it for disposal or irrigation purposes at a later date. Further, the mix of technologies will be customized to the different land uses of the community. This will assure that the improved stormwater capture capacity is well distributed and integrates into the fabric of each community. It will also serve to model that many different types of property can participate in the use of green infrastructure. While addressing basement flooding is a driving purpose of the program, it is also important to build infrastructure that has additional environmental, social, and economic benefits to the WSDA. Thus, the City evaluated investments that both maximize reduction in flooding and provide significant co-benefits.

C. Geographical Boundaries of Project

The West Side Demonstration Area (WSDA) includes 94 census tracts in the City of Chicago that constitute the Austin, Humboldt Park, East Garfield Park, West Garfield Park, North Lawndale, and South Lawndale community areas. As described in the Phase I application, this area was selected to

assure the proposed project would help alleviate and reduce flooding in communities where the financial need is greatest and would overwhelmingly benefit minority communities. 88% of these census tracts are Low-Moderate Income areas. Blacks and Hispanics make up over 90% of the population in these areas and each of the six communities has: over 28% of households living below poverty; per capita income levels below \$15,957; and unemployment rates above 15%, nearly three times the current national average (GD: Data03). In its four main zip codes (60623, 60624, 60644, and 60651), 2,900 residents received over \$6.3 million in FEMA Household Assistance as of October 2013. A map of the WSDA and of the individual communities is provided in Attachment E.

D. Main Components of Proposal Plan

As detailed in the full application, the primary technologies of the proposed project include:

- Bioretention Basins (BB)
- Detention Basins (DB)
- Downspout Disconnections (DD)
- Flow-through planters (FT) as a form of bioretention
- Permeable pavement (PP)
- Rainwater harvesting (RH)
- Urban Agriculture (UA)
- Street Tree Planting (TP)

Table 24 in details the quantities of these technologies by area

For the purpose of planning and modeling, potential sites were divided into ten land-use categories, each with a specified mix of appropriate mechanisms. (For allocation of costs to each category, see Figure 2.)

- Public Facilities, including schools and transit maintenance – BB, PR, RH
- Vacant Commercial Land [anticipated for redevelopment with stormwater reduction elements] – PP plazas, FT, UA, BB

- Secondary Commercial Land anticipated for full conversion to public use with stormwater reduction benefits – PP plazas, FT, UA, BB
- Parks – BB, PP, DD, DB with renovated public open space
- Industrial Properties, vacant – BB, PP, FT
- Residential – DD, BB, FT, TP
- Neighborhood Complete Streets – PP, BB (as part of curb bulb-outs), TP, lighting, bike lanes
- Commercial Complete Streets – PP, BB as part of curb bulb-outs, TP, lighting and bike lanes
- Boulevard – PP and BB curb bulb outs in the residential parkways + sidewalks and landscaping
- Green Alleys – PP

E. Impact of Anticipated Policy Changes

The City of Chicago has already enacted key policy changes that will transform stormwater capacity incrementally over time as new infrastructure is built.

In 2008, the City of Chicago's Stormwater Management Ordinance (Municipal Code 11-18) took effect. Under this ordinance, the City will only provide construction permits to projects that disturb 15,000 sq. ft. (or create an impervious surface of 7,500 sq. ft) only if they implement a plan to manage stormwater runoff that captures at least one-half inch of runoff from impervious surfaces.

In 2013, the City also approved Sustainable Urban Infrastructure Guidelines (SUIG) in 2013 that apply to construction of transportation infrastructure and in the public way. Climate Resilience and Stormwater Management were key elements of the Guidelines. The SUIG specifies, "To the extent practicable, green infrastructure systems shall be installed ...and shall be used to intercept runoff upstream of ROW catch basins to maximize the area available for infiltration and water loss through evapotranspiration.

Stormwater BMP's shall maximize lateral distribution of stormwater storage and inter-connect individual BMP's to increase opportunities for infiltration and to minimize points of overflow into the sewer system." It also specifies that the target release rate for the project's right-of-way (ROW) shall be 0.9cfs/acre for the 5-year event.

While both programs will improve stormwater capacity incrementally as new infrastructure is built, it may only help keep pace with the increasing frequency of high-volume rainstorms. Further, benefits from the Stormwater Ordinance are slowest to appear in areas where fewer large private developments are anticipated, such as the West Side Demonstration Area. Therefore targeted interventions such as the one in this application are still needed to make more immediate increases in community recovery capacity.

F. Timeline for Completion

The City's proposal is comprised of several project areas with a range and scale of interventions that will be delivered by seven different agencies. This design allows some of the projects (i.e. residential retrofits, tree planting, sewer upgrades) to begin delivery as soon as the second half of 2016, while larger public infrastructure projects (Commercial Complete Streets, Regional Park Resiliency project) will begin the community outreach and design processes. The projected schedule is to complete all capital projects by 2020 as outlined in Exhibit E: Soundness of Approach.

G. Estimated Useful Life of the Proposal

The proposed solution features green infrastructure, which has a useful life of 30 years. For the Benefit Cost Analysis, AECOM assumes all investments have a useful life of 30 years. This is conservative considering some of the grey infrastructure and affordable housing investments within the WSDA.

H. Alternative Discount Rates

BCA metrics are presented with both the recommended 7 percent discount rate and a lower 3 percent discount rate that can be applicable for government funded Projects. The proposed Project has a positive BCR and NPV under both discount rates. Furthermore, the life cycle analysis does not inflate costs but expresses all costs and benefits in current year terms.

4. Risks if Not Implemented

A. Impact by Timeframe

1) Impact Now/5 years

This Benefit Cost Analysis aims to quantify the difference between the current state of environmental, social, and economic distress caused by chronic flooding and the benefits gained after proposed project implementation. The full set of benefits from GI start to accrue after construction completes in 2022, though benefits from the sewer projects activate in 2021.

It is clear how much the vulnerable and socio-economically disadvantaged community will benefit when comparing the current state to the avoided costs, quantified benefits, and qualitative benefits that the project implementation promises. For example, the property damages from flooding were compared to the property damages expected after implementation of the proposed GI and sewer projects for 1-, 2-, and 5-year recurrence interval storms to calculate the total average annual average damage reduction. For instance in Area 5, property damages are estimated to be approximately \$422 million. Using the same process, the total average annual property damages after project implementation are estimated at \$413 million. This means that the average annual benefit in reduced property damage for Area 5 is over \$9 million.

2) Impact in 20 Years/50 Years

Based on recurrence intervals, with a twenty year span the City would face a two “10-year” storms, four “5-year” storms, ten “2-year” storms and twenty “1-year” storms, resulting in millions of dollars of additional damage and public health risks with each occurrence.

However, flooding frequency is very likely to increase due to climate change. According to the National Climate Assessment, average annual precipitation in Chicago could increase 3.2 to 4 inches, and events of heavy precipitation are expected to increase as well.

Already the current definitions are beginning to appear moot. The Chicago region has experienced four storms in the last six years that exceeded the rainfall amount of a “10-year” storm as measured over a 2-day period at the rain gauge at O’Hare Airport.

B. Impact on Community

The impact on Chicago as a whole would be a continued stress on stormwater capacity during heavy storms. Resultant flooding and property damage will disrupt the lives of homeowners and renters.

Vulnerable low income populations will face this damage with reduced capacity for dealing with such events, either due to direct lack of funds and/or loss of income from missing work to resolve issues. Even those in less vulnerable housing will be impacted by disrupted roadways, co-workers absent as they deal with storm impacts, and the pass-through of increased emergency response and repair costs by utilities and public agencies.

C. Missed Additive Impacts or Benefits

If economic development benefits are not realized because the proposed green infrastructure components are not completed, then the Planned Housing Improvements included as a direct financial commitment may still progress as planned, but their net benefit to community cohesion will be reduced.

D. Area of Poverty Remaining Adversely Affected

The West Side Demonstration Area (WSDA) would remain adversely affected by sewer overflow if the proposed program of improvements is not implemented. As cited previously, 88% of the 94 census tracts in the WSDA are Low-Moderate Income areas. Each of the six communities in the WSDA has over 28% of households living below poverty; per capita income levels below \$15,957; and unemployment rates above 15%, nearly three times the current national average.

E. Costs Avoided

Benefits are measured both by direct or indirectly injected positive values, such as new jobs and the recreation benefits of green space, and by avoided costs. For instance, reduced property damage and

reduced asthma cases requiring treatment are examples of avoided costs. The average annual avoided direct damages to property are estimated at approximately \$32 million per year after full implementation in 2022.

5. Benefits and Costs

A. Approach to Sources and Analysis

The Benefit-Cost Analysis (BCA) was conducted using the Phase 2 BCA Instructions for Community Development Block Grant National Disaster Resilience (CDBG-NDR) Applicants (Appendix H) as a guide for preferred methods and monetized values. A BCA model was specifically developed by AECOM to estimate the Project's total future costs and benefits. AECOM has performed triple bottom line and benefit cost assessments for water, wastewater, stormwater, transportation, and development projects throughout the United States. The parameters of the BCA follow the protocols set by OMB Circular A-94 as well as the recommended benefit cost methods by the U.S. Department of Transportation, the United States Army Corps of Engineers, and the Federal Emergency Management Agency. The analysis follows a conservative estimation of the benefits and categorizes many of the potential economic and societal benefits as qualitative. By adhering to a strict standard of what could be included in the BCA, actual total program benefits may be greater than depicted in the BCA.

The overall project serves six Chicago neighborhood areas: Austin (Area 1), Humboldt Park (Area 2), East Garfield Park (Area 3), West Garfield Park (Area 4), North Lawndale (Area 5), and South Lawndale (Area 6). The analysis is broken in to five study areas, with neighborhood Area 3 and Area 4 combined into one study area.

Four primary categories of benefits were quantified: resiliency, economic revitalization, social, and environmental. Additional benefits were assessed but not included in the BCA ratio and are described in the qualitative section.

Generally, standard factors and values from Federal Agencies are used for the BCA calculation except in cases where more specific values or prices are available for a more accurate quantification of the Project's estimated future benefits or costs. In all such cases, modifications are noted and references are provided for all data sources.

[NOTE: ALL FIGURES BELOW ARE PRELIMINARY. THE BCR WILL CHANGE AS COSTS ARE FINALIZED AND AS ADDITIONAL LEVERAGE COMPONENTS ARE ADDED IN.]

Table 3 shows the overall BCA results for the total combined Project. BCA metrics are presented with both the recommended 7 percent discount rate and a lower 3 percent discount rate that can be applicable for government funded Projects. The proposed Project has a positive BCR and NPV under both discount rates. The Economic Rate of Return (ERR) and Return on Investment (ROI) is also favorable for both discount rates. At a 7-percent real discount rate, the Project generates a NPV over \$258 million, BCR of 2.0, ECC of 14 percent, and ROI of 170 percent. At a 3-percent real discount rate, the Project generates a NPV over \$715 million, BCR of 3.2, ERR of 14 percent, and ROI of 347 percent.

Table 3: Overall Benefit Cost Analysis Results

Metric	7% Discount Rate	3% Discount Rate
Net Present Value (NPV) (2015 \$)	\$258,139,816	\$715,246,296
Benefit-Cost Ratio (BCR)	2.0	3.2
Economic Rate of Return (ERR)	14%	14%
Return on Investment (ROI)	170%	347%

The BCA metrics were also evaluated for each study area. The results for each of the study areas are provided in Table 4. These results are based on a 7-percent real discount rate.

Table 4: Benefit-Cost Analysis Results by Area

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6	Total
Capital Cost	\$72,238,262	\$73,078,772	\$71,676,529	\$49,936,777	\$32,367,000	\$299,297,339
Net Present Value	\$60,125,173	\$37,846,740	\$34,750,363	\$74,755,710	\$50,105,159	\$258,139,816
Benefit Cost Ratio	2.0	1.6	1.6	2.8	2.9	2.0

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6	Total
Internal Rate of Return	14%	11%	11%	19%	19%	14%
Return on Investment	166%	137%	132%	235%	237%	170%

NOTE: THE TABLE BELOW IS NOT FINAL to be updated and aligned according to final content in section VI.

B. Table Summarizing Benefits

Table 5: Summary of Benefits and Costs

Cost or Benefit Criteria	Page # Ref.	Description / Rationale	Qualitative Impact	Quantitative Assessment	Annualized Monetized Effect (\$)	Uncertainty (1=very certain, 5=very uncertain)
LIFECYCLE COSTS						
Annual O&M	XX					
Annual Project Cost	XX					
Annual Lifecycle Cost	XX					
ECONOMIC REVITALIZATION						
Retail Sales	29	Creating an inviting and pleasant atmosphere with landscaping and trees can make local businesses more attractive for shopping.		5% net new retail purchases to project areas based off of current retail, food and drink sales in the West Side Submarket.	\$18,528,065	3
Property Values	29	Planting trees within 100 feet of a residential property is expected to increase the value of the property.		Average property value increase with GI: 3.7 to 7%	\$1,174,968	4
Maintenance Jobs	30	The project operations will generate 35 to 45 maintenance jobs per year.		80% of annual operation and maintenance budget for each area will be used for labor.	\$3,199,520	2
Construction Jobs	45	The project construction will generate nearly 1000 jobs per year.	Scale: +	55% of annual capital costs and 100% of soft costs will be used for labor.	N/A	3

Cost or Benefit Criteria	Page # Ref.	Description / Rationale	Qualitative Impact	Quantitative Assessment	Annualized Monetized Effect (\$)	Uncertainty (1=very certain, 5=very uncertain)
Workforce Development	45	The GreenCorps work training program benefits a community where the average unemployment rate is 18.5 percent and the average per capita income is just under \$13,000.	Scale: ++	15 to 30% of the project workforce is expected to be GreenCorps workers.	N/A	
Affordable Housing	45	Affordable housing's economic and social benefit is measured by the housing stability between the market rent and affordable housing.	Scale: ++	Leverages private investment.	N/A	3
ENVIRONMENTAL						
Energy use	43	Newly planted trees provide shade to nearby buildings, thereby reducing costs for heating and cooling and saving energy.		Electricity benefit is \$7.07 per tree and natural gas benefit is \$29.78 per tree.	\$156,391	3
Water savings	39	Water conserved through rainwater harvesting can be used as greywater and offsets purchasing water from the City.		The value of the water savings is monetized using the gallons of rainwater conserved and the cost of purchasing water.	\$70,859	4
Stormwater Runoff	37	Reduced stormwater runoff is valued using the avoided water treatment cost.		The stormwater benefits for the newly planted trees were calculated separately from the other GI measures.	\$89,889	2

Cost or Benefit Criteria	Page # Ref.	Description / Rationale	Qualitative Impact	Quantitative Assessment	Annualized Monetized Effect (\$)	Uncertainty (1=very certain, 5=very uncertain)
Nutrient pollution	40	Reduced runoff from phosphorus and nitrogen reduces water treatment and public health costs.		Phosphorus: \$38.88/pound based off of bioretention facility size and 15 lbs/acre/year removal. Nitrogen: \$3.71/pound based off of bioretention facility size and 2 lbs/acre/year removal.	\$9,984	3
Ecosystem and biodiversity	41	Green infrastructure creates new habitat which contributes to increased ecosystem and biodiversity benefits		\$307.75/acre/year	\$8,556	3
Temperature	41	Reduced urban heat-island effect improves climate.		\$13.99/acre/year for open space + \$419.30 acre/year for trees	\$4,343	3
Air quality	38	Trees absorb pollutants, reduce CO ₂ , remove particulates, and reduce temperature		Trees can remove air pollutants, and store and sequester carbon dioxide. They can also remove particulates and reduce temperatures. The air quality benefits for newly-planted trees were quantified separately from the other GI measures using the air quality value per acre of trees of \$239.39 established by FEMA.	\$7,520	2
RESILIENCY						

Cost or Benefit Criteria	Page # Ref.	Description / Rationale	Qualitative Impact	Quantitative Assessment	Annualized Monetized Effect (\$)	Uncertainty (1=very certain, 5=very uncertain)
Property Damage	25	The green infrastructure (GI) measures and sewer projects are most effective for the 2-year flood event and the reduction in damages for the 6-month chance event and 10-year chance event are expected to be minimal. As a result, the BCA focuses on the 1-year, 2-year and 5-year flood events.		Reduction in damages captured by a measure of structural damage from the without-project (baseline) condition, averaged over the 1-, 2-, and 5-year storms.	\$22,592,188	3
Sewer	26				\$9,072,857	
Avoided emergency response costs	44	Costs are incurred by Federal, State, and local government agencies to provide emergency services during a flood and debris removal after a flood.	Scale: +		N/A	5
Avoided evacuation and subsistence costs	44	Per diem rates + Incremental cost of food multiplied by 30% of residential structures damaged during average 1-, 2-, and 5-yr floods, with and without project.	Scale: +		N/A	2
Reduced property damages - property content	43	Content damage is 70% of structure damage.	Scale: ++		N/A	3

Cost or Benefit Criteria	Page # Ref.	Description / Rationale	Qualitative Impact	Quantitative Assessment	Annualized Monetized Effect (\$)	Uncertainty (1=very certain, 5=very uncertain)
Reduced property damages - reoccupation / homeowner clean-up	43	Homes damaged by flooding often require clean-up by homeowners before residents can reoccupy.	Scale: +		N/A	4
SOCIAL						
Living Environment: Aesthetics + Recreation	33	The monetized value of the improved living environment includes the recreation benefit from the creation of new green space in areas that were previously vacant lots and the aesthetic value from the creation of green open space.		Calculated using FEMA inputs and the number of acres of new green and open space.	\$3,366,214	3
Health	33	Green and open spaces contribute to reduced asthma cases and treatment; new bike lane contributes to health benefits.			\$427,965	2
Mobility	34	The design of selected streets in the study areas are expected to reduce accidents.			\$291,190	3
Decreased Auto Use	34	The redesign of the streets, including adding new bicycle			\$10,919	3

Cost or Benefit Criteria	Page # Ref.	Description / Rationale	Qualitative Impact	Quantitative Assessment	Annualized Monetized Effect (\$)	Uncertainty (1=very certain, 5=very uncertain)
		lanes, is expected to decrease automobile use.				
Safety	35	Reflects reduced number of accidents			\$5,268,466	3
Reduced diabetes cases/treatment	45	Access to public green and open space reduces incidences of diabetes type II.	Scale: +		N/A	4
Reduced mental health issues/services	45	Chronic flooding and larger-scale storms can contribute to psychological and mental stress, including anxiety disorders, PTSD, and depression. A resilient community minimizes potential service costs.	Scale: +		N/A	3
Reduced crime	45	Regression-adjusted models showed consistent and statistically significant reductions in narcotics possession (18%–27% less) within 16th mile, quarter-mile, half-mile ($P < .001$), and eighth-mile ($P < .01$) distances from urban green stormwater infrastructure.	Scale: +		N/A	4

C. Summary and Quantitative Methodology

Benefits for GI were estimated over a 30 year period after construction would be completed in 2022 until 2052. Benefits for the sewer projects begin in 2021. Since costs would begin accruing next year, the analysis period for the BCA begins in 2016 and ends in 2052.

The base year is 2015 and all values are expressed in 2015 constant dollars, except where noted. The benefits and costs are expressed in constant dollars, which avoids forecasting future inflation and escalating future values for benefits and costs accordingly. The U.S. Bureau of Labor Statistic's Consumer Price Index for Urban Consumers (CPI-U) is used to adjust past cost estimates or price values into 2015 dollars terms (BLS, 2015c). The use of constant dollar values requires the use of a real discount rate for present value discounting. Future values are shown below after application of a 7-percent discount rate in accordance with the NOFA. An alternative analysis was also conducted, using a 3 percent real discount rate.

1) Resiliency

GI measures are expected to have the greatest impact for reducing flooding during the 1-year, 2-year and 5-year flood events. Reduced flooding translates to reduced property damages and reduced costs for emergency response, reoccupation, and evacuation and subsistence.

Reduced Property Damages from GI and Sewer Projects

When managing flood risk, benefits represent the reduction in damages captured by a measure or measures from the without-project (baseline) condition. Therefore, benefits are calculated as the difference between the without-project damages and with-project damages.

The damages referred to in both cases represent damages resulting from future flooding of relatively uncertain frequency and quantity, therefore damages are evaluated in average annual terms. To estimate average annual damages from future flooding, five flooding events were modeled by hydrology and hydraulics (H&H) engineers, representing a range of occurrence probabilities from a 6-month chance

event to a 10-year chance event. The green infrastructure (GI) measures and sewer projects are most effective for the 2-year flood event and the reduction in damages for the 6-month chance event and 10-year chance event are expected to be minimal. As a result, the BCA was focused on the 1-year, 2-year and 5-year flood events. Reduced flooding from implementation of the GI measures and sewer projects extend well beyond each of the study areas. The H&H modeling provided the level of flooding for the entire area that would be affected by the GI measures and sewer projects both with- and without-project, see “Soundness of Approach” section for more detail.

The structure inventory is comprised of residential and nonresidential structures within the study area and was provided by the United States Army Corps of Engineers (USACE), Chicago District using the HEC-FDA model. The affected area is predominantly residential, with 83.5 percent of all structures being single or multifamily residences. The remaining 16.5 percent is divided between nonresidential structures, such as commercial, industrial and public buildings. The characteristics of the structures within the study areas were extrapolated to the surrounding areas.

The total number of structures in all of the study areas by occupancy type, the average depreciated structure value, and the average depreciated content value provided by USACE, Chicago District are presented in Table 6. Since only basement flooding typically occurs in the 1-year, 2-year and 5-year flood events, structures without basements are not expected to be impacted by these events.

Table 6: Study Area Structure Profile

Occupancy Type	# of Structures	% of Total	Average Structure Value	Average Content Value
Residential, one-story	863	7.6%	\$109,305	\$109,305
Residential, split-level	18	0.2%	\$97,989	\$97,989
Residential, two or more stories	4,569	40.1%	\$177,194	\$177,194
Residential, without basement	4,076	35.7%	\$157,228	\$157,228
Protective Services, 5 stories or less	481	4.2%	\$33,719	\$1,539
Protective Services, 6 or more stories	12	0.1%	\$31,416	-
Industrial Warehouse, 5 stories or less	318	2.8%	\$108,038	\$64,826
Industrial, without basement	87	0.8%	\$112,948	\$67,332
Commercial, 5 stories or less	162	1.4%	\$163,272	\$97,963
Commercial, 6 to 18 stories	4	0.04%	\$319,750	\$191,825
Commercial, electronic, 5 stories or less	497	4.4%	\$102,522	\$61,511

Occupancy Type	# of Structures	% of Total	Average Structure Value	Average Content Value
Commercial, hotel/motel, 5 stories or less	3	0.03%	\$260,300	\$156,167
Commercial office building, 5 stories or less	285	2.5%	\$156,862	\$94,120
Commercial office building, 6 to 18 stories	2	0.02%	\$179,750	\$107,850
Commercial, without basement	28	0.3%	\$606,191	\$363,038

Damages depicted in Table 6 include damages to structures and damages to structure contents. Each type of structure is assigned a depth-damage function (DDF) that is specific to Chicago and was obtained from the USACE, Chicago District. The DDF estimates an economic loss as a percentage of the structure's value by depth of flooding (from the H&H modeling). Content damages are estimated similarly to structure damages. For 1 to 5 feet of flooding in the basement, only residential structures are expected to have any content damage.

The average annual damages were calculated for the each flood event for the baseline (without-project conditions) and the after the implementation of the project (with-project conditions). The benefit is the difference between the with- and without-project. A summary of the average annual benefit by area is presented in Table 7.

Table 7: Average Annual Benefit of Reduced Property Damages from Future/Repeat Flood Events

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Reduced Damages from GI Measures	\$3,859,039	\$2,520,289	\$4,803,871	\$8,274,671	\$3,134,318
Reduced Damages from Sewer Projects	\$2,000,033	\$2,889,624	\$3,289,424	\$893,775	\$0
Average Annual Benefit	\$5,859,072	\$5,409,913	\$8,093,295	\$9,168,446	\$3,134,318

2) Economic Revitalization

The project areas are located in dilapidated areas in dire need of economic revitalization. The residents of the selected neighborhoods are low-income families. A summary of the economic revitalization benefits is presented in Table 8.

Table 8: Summary of Economic Revitalization Benefits

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6	Annual Total
Revitalization of Neighborhood Business	\$4,803,474	\$3,225,438	\$1,810,344	\$3,615,683	\$5,073,126	\$18,528,065
Increased Property Values from Planting Trees	\$309,546	\$305,148	\$263,968	\$193,919	\$102,387	\$1,174,968
New Permanent Jobs	\$745,600	\$813,600	\$701,600	\$609,600	\$329,120	\$3,199,520
Total Annual Economic Revitalization Benefit	\$5,858,620	\$4,344,186	\$2,775,913	\$4,419,201	\$5,504,633	\$22,902,553

Retail Sales - Revitalization of neighborhood business

Creating an inviting and pleasant atmosphere with landscaping and trees can make local businesses more attractive for shopping. In New York City over a three year period, retail sales increased by 49 percent in an area where the street landscaping was improved (NYCDOT, 2012). These results were scaled to the Chicago study area using employment (BLS, 2015a), payroll (BLS, 2015b), and retail sales revenues (City of Chicago, 2013). Using these measures, Chicago is approximately 28 percent the size of New York City, therefore, the growth in retail sales was scaled to 13.6 percent (28 percent of 49 percent). As a conservative estimate, implementation of the GI measures is estimated to increase retail sales in the study areas by 5 percent.

The retail sales for each study area were estimated using the total sales by category for the entire West Side of Chicago and then separated by area based on the number of each store type in each of the study areas. Table 9 displays the number of retail stores by category located in each of the study areas.

Table 9: Number of Retail Stores by Area and Category

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Furniture & Home Furnishings	2	1	1	0	0	5
Electronics & Appliance	9	4	1	0	7	9

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Home Improvement	1	2	2	0	1	0
Food and Beverage	29	24	9	8	35	31
Health & Personal Care	6	3	0	1	5	5
Clothing & Accessories	10	9	1	0	4	39
Sporting Goods, Hobby, Books, Music	0	1	0	0	0	8
General Merchandise	5	4	1	0	0	4
Misc. Retail	1	0	0	1	2	2
Eating/Drinking/Entertainment	34	18	4	7	24	35
Auto Sales & Service	19	10	1	3	10	14
Filling Station	3	2	1	1	2	0

The proportion of retail sales for each area was based on the share of retail stores for each category. Table 10 displays the total retail sales and the sales for each area in 2012 dollars (City of Chicago, 2013). Retail Sales were converted from 2012 dollars to 2015 dollars using the CPI-U (BLS, 2015c).

Table 10: Retail Sales and Benefit by Study Area

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Estimated Total Sales (2012\$)	\$92,428,601	\$62,063,982	\$17,632,187	\$17,202,519	\$69,573,083	\$97,617,247
Retail Sales Benefit (2012\$)	\$4,621,430	\$3,103,199	\$881,609	\$860,126	\$3,478,654	\$4,880,862
Annual Retail Sales Benefit (2015\$)	\$4,803,474	\$3,225,438	\$916,337	\$894,007	\$3,615,683	\$5,073,126

Increased property values - other than through enhanced flood protection

Planting trees within 100 feet of a residential property is expected to increase the value of the property. Two sources were used to provide a low and high estimate of property value increases from planting trees within 100 feet of residential homes in each study area.

Based on a study from the Landscape and Urban Planning journal (Donovan, et. al. 2010) and adjusting the study values based on average property values for each study area obtained from the U.S. Census, planting trees nearby would increase property values by about 3.7 percent, an average benefit of about

Page 30 of 52

\$7,500. The property value increase was estimated using the original 2010 estimate for East Portland from the Donovan study and comparing it to the average value of homes in East Portland in 2010 (\$238,000) obtained from the Regional Market Listing Service to get the proportion of the benefit to apply to each study area. The results are considered to be a conservative estimate of the property value benefit to low-income households from planting trees within 100 feet of the home. Another study estimated that residential property values would increase by 7 percent from planting trees (Kusnierz, et. al. 2010). When a 7 percent increase in property values is applied to the study area, the average benefit is about \$14,100.

The average value of the low and high estimates was used to estimate the total BCA results and the low and high values were used in the uncertainty analysis to determine the impact on the overall results. The increased property values from planting new trees in each area are presented in Table 11.

Table 11: Increased Property Value from Planting Trees

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Avg. Residential Property Value	\$218,382	\$208,829	\$213,893	\$190,502	\$178,175
Min Property Value Increase	\$8,139	\$7,783	\$7,972	\$7,100	\$6,640
Max Property Value Increase	\$15,287	\$14,618	\$14,973	\$13,335	\$12,472
Number of Properties Impacted	518	534	451	372	210
Total Benefit	\$6,067,237	\$5,981,038	\$5,173,893	\$3,800,891	\$2,006,828
Annualized Benefit	\$309,546	\$305,148	\$263,968	\$193,919	\$102,387

Permanent Jobs - Direct effects on local economy net of opportunity costs

Based on similar City projects, it is assumed that 80 percent of the annual operation and maintenance budget for each area would be used for labor and the remaining 20 percent would be used for materials.

The value of new permanent jobs in the local economy is presented in Table 12. These are the direct impacts only and do not include the indirect and induced benefits from creating new jobs.

Table 12: Value of New Permanent Jobs in the Local Economy

Area 1	Area 2	Area 3 & 4	Area 5	Area 6
\$745,600	\$813,600	\$701,600	\$609,600	\$329,120

The program would generate approximately 45 full-time equivalent maintenance jobs per year. The jobs were estimated using Impact Analysis for Planning (IMPLAN), a program that enables sector- and location-specific economic impact analyses. Eighty percent of the operations cost was entered into the IMPLAN input-output model and classified by a sector code for maintenance services to buildings and dwellings.

3) Social

The project is expected to improve the living environment, reduce human suffering, increase mobility, decrease automobile use, and reduce traffic accidents. A summary of the social benefits is presented in Table 13.

Table 13: Summary of Social Benefits

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6	Annual Total
Aesthetic	\$19,748	\$20,535	\$22,482	\$17,223	\$11,603	\$91,590
Recreation	\$512,148	\$829,953	\$546,755	\$684,575	\$701,193	\$3,274,624
Health	\$21,251	\$32,624	\$22,351	\$29,157	\$322,582	\$427,965
Mobility	\$47,575	\$72,694	\$47,575	\$59,022	\$64,324	\$291,190
Decreased Autos	\$947	\$4,112	\$947	\$2,119	\$2,794	\$10,919
Safety	\$2,737,407	\$1,677,823	\$137,587	\$579,817	\$135,832	\$5,268,466
Total Annual	\$3,339,075	\$2,637,741	\$777,697	\$1,371,913	\$1,238,327	\$9,364,754

New Bike Lane Benefits

Adding bike lanes in each of the study areas is expected to increase recreation, improve health and mobility, and reduce the use of automobiles as people choose to bike instead of driving to nearby locations. The benefits of adding new bike lanes in each study area were estimated using the BCA of Bicycle Facilities tool from the Pedestrian and Bicycle Information Center (PBIC, 2015). The results were generated using the defaults provided in the tool for Chicago and the length of the new bike lanes for each

study area. The estimates provided by the tool are based on an 18-month study of the benefits and costs of bicycle facilities, funded by the National Cooperative Highway Research Program (NCHRP) and the Minnesota Department of Transportation. The full methodology for the BCA tool is provided online (<http://www.pedbikeinfo.org/bikecost/methodology.cfm>) and is based on the *NCHRP Report 552: Guidelines for Analysis of Investments in Bicycle Facilities*. The tool provides a low estimate, mid-range estimate and high estimate for the recreation benefits of the new bike lanes. To be conservative, only the low estimates were included in the BCA. A summary of the benefits from the new bike lanes is provided in Table 14.

Table 14: Summary of Benefits from the New Bike Lanes

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Recreation Benefit	\$501,219	\$807,185	\$501,219	\$637,616	\$700,795
Health Benefit	\$19,516	\$31,430	\$19,516	\$24,827	\$320,804
Mobility Benefit	\$47,575	\$72,694	\$47,575	\$59,022	\$64,324
Decreased Auto Use Benefit	\$947	\$4,112	\$947	\$2,119	\$2,794
Annual Benefit From New Bike Lanes	\$569,257	\$915,421	\$569,257	\$723,584	\$1,088,717

Improved Living Environment: Aesthetic and Recreation Benefits

The monetized value of the improved living environment includes the recreation benefit from the creation of new green space in areas that were previously vacant lots and the aesthetic value from the creation of green open space. These benefits are not expected to capture the full improved living environment benefits to the community from the project. The recreation value of new green space was estimated based on the number of acres of new green space in each study area and the value specified by the Federal Emergency Management Agency of \$5,692 per acre (FEMA, 2013). The aesthetic value includes all the newly created acres of open space from the project and monetized using the aesthetic value of open space from FEMA of \$1,721 per acre (FEMA, 2013).

Table 15: Summary of Improved Living Environment Benefits

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6

Aesthetic value of open space	\$19,748	\$20,535	\$22,482	\$17,223	\$11,603
Recreation value of open space	\$10,929	\$22,768	\$45,536	\$46,959	\$398
Recreation benefit of bike lane	\$501,219	\$807,185	\$501,219	\$637,616	\$700,795
Total annual benefit input	\$531,895	\$850,488	\$569,237	\$701,798	\$712,796

Health

The health benefits reflect reduced incidences of asthma and associated treatment costs, and health and recreation benefits from a new bike lane. See New Bike Lane Benefits for more information.

Table 16: Summary of Benefits from Health

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Asthma reduction	\$1,735	\$1,194	\$2,835	\$4,330	\$1,778
Health benefit from new bike lane	\$19,516	\$31,430	\$19,516	\$24,827	\$320,804
Total annual benefit input	\$21,251	\$32,624	\$22,351	\$29,157	\$322,582

Mobility

Mobility measures the ability of residents to move within their community. See New Bike Lane Benefits for more information.

Table 17: Summary of Mobility Benefits

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Length (ft) of new bike lane with on-street parking	5,400	14,600	5,400	9,500	11,400
Meters of new bike lane	1,646	4,450	1,646	2,896	3,475
Total annual benefit input	\$47,575	\$72,694	\$47,575	\$59,022	\$64,324

Decreased Auto Use

The redesign of the streets, including adding new bicycle lanes, is expected to decrease automobile use.

See New Bike Lane Benefits for more information.

Table 18: Summary of Decreased Auto Use Benefits

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Total annual benefit input	\$947	\$4,112	\$947	\$2,119	\$2,794

Safety

The design of selected streets in the study areas are expected to reduce accidents. The current average annual number of accidents, based on Illinois Department of Transportation (IDOT) crash data extracts from 2009 to 2013, is presented in Table 19.

Table 19: Current Average Annual Accidents, by Project Area

Project Area	PDO	No Apparent Injury	Minor Apparent Injury	Major Apparent Injury	Fatal
1	173	27	29	5	0.8
2	176	23	36	7	0.6
3 & 4	26	4	5	1	-
5	87	13	18	5	0.2
6	90	11	12	2	-
Total	552	79	100	20.2	1.6

The number of accidents after project implementation is presented in Table 20.

Table 20: Projected Accidents After Project Implementation

Project Areas	PDO	No Apparent Injury	Minor Apparent Injury	Major Apparent Injury	Fatal
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Project Areas	PDO	No Apparent Injury	Minor Apparent Injury	Major Apparent Injury	Fatal
1	151	22	23	4	0.5
2	161	20	32	6	0.4
3 & 4	24	3	4	1	-
5	81	12	17	5	0.2
6	84	10	11	2	-
Total	502	68	87	17.6	1.1

Benefits were monetized based on the reduced number of accidents (the difference between before and after project implementation), as shown in Table 21.

Table 21: Reduction in Accidents

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Reduced # of PDO	21	14	3	6	7
Reduced # of no injury accidents	5	3	1	1	1
Reduced # of minor injury accidents	5	4	1	2	1
Reduced # of major injury accidents	1	1	0	1	0
Reduced # of fatal accidents	0.3	0.2	-	0.0	-

The conversion matrix from USDOT (2015) was used to convert the number of accidents to the Abbreviate Injury Scale (AIS). Recommended AIS values from HUD were updated to 2015 dollars and used to monetize the safety benefits. The results are summarized in Table 22.

Table 22: Economic Impact of Reduced Accidents, by Project Area

AIS	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
0 – Property Damage Only	\$103,458	\$67,011	\$12,521	\$26,427	\$30,748
1 - Minor	\$77,288	\$64,140	\$10,004	\$25,448	\$18,185
2 - Moderate	\$61,357	\$56,399	\$14,873	\$38,064	\$11,364
3 – Serious	\$83,143	\$76,884	\$20,328	\$52,073	\$15,321
4 – Severe	\$31,002	\$28,690	\$7,588	\$19,440	\$5,709
5 - Critical	\$295,724	\$273,382	\$72,272	\$185,126	\$54,506
Fatality	\$2,085,435	\$1,111,317	\$0	\$233,239	\$0

Annual Value	\$2,737,407	\$1,677,823	\$137,587	\$579,817	\$135,832
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4) Environmental

The environmental benefits are based on the green infrastructure design for each study area. A summary of the environmental benefits is presented in Table 23 and green infrastructure measurements that were used to estimate these benefits are presented in Table 24.

Table 23: Summary of Environmental Benefits

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6	Total
Reduced Stormwater Runoff	\$25,446	\$18,961	\$17,889	\$20,305	\$7,287	\$89,889
Water Recovered/Reused	\$16,799	\$15,865	\$22,578	\$9,514	\$6,102	\$70,859
Improved Air Quality	\$1,018	\$1,521	\$2,361	\$2,332	\$288	\$7,520
Reduced Nutrient Pollution	\$2,300	\$2,170	\$2,214	\$2,100	\$1,201	\$9,984
Ecosystem and Biodiversity Effects	\$1,847	\$1,964	\$2,123	\$1,775	\$848	\$8,556
Reduced Urban Heat-Island Effect	\$1,049	\$1,085	\$936	\$774	\$499	\$4,343
Reduced Energy Use	\$38,177	\$39,393	\$33,202	\$27,416	\$18,204	\$156,391
Total Average Annual Environmental Benefit	\$86,636	\$80,958	\$81,303	\$64,217	\$34,429	\$347,542

Table 24: Green Infrastructure Measures by Study Area

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Urban agriculture (SF)	12,545	26,136	52,272	53,906	457
Bioretention facilities (SF)	208,731	196,898	200,899	190,556	108,972
Detention basin (gallons)	3,279,840	2,592,000	1,440,000	2,295,360	105,120
Rainwater harvesting (gallons)	440,480	416,000	592,000	249,472	160,000
Permeable pavement (SF)	281,121	295,010	315,810	193,133	184,214
Downspout disconnection (acres of roof disconnected)	138	77	96	122	40
Number of planted trees	1,036	1,069	901	744	494
Acres from planted trees	2.4	2.5	2.1	1.7	1.1
New Environmental Green Open Space (acres)	3.6	3.9	4.8	4.1	1.6

Note: SF = square feet

Reduced Stormwater Runoff

Implementing GI measures is expected to reduce stormwater runoff in each of the project areas. The value of reduced stormwater was monetized using the gallons of stormwater that would be reduced annually and the value of each gallon. Reduced stormwater runoff is valued using the avoided water treatment cost of \$0.000093 per gallon (Alon, et. al. 2014). The stormwater benefits for the newly planted trees were calculated separately from the other GI measures using the i-Tree Tool, peer-reviewed software from the USDA Forest Service (itreetools.org). This tool calculated a stormwater benefit of \$5.78 per tree for the Chicago area.

GI measures can vary in the level of effectiveness. This variability is accounted for in the model using minimum and maximum values for the number of gallons of stormwater that can be reduced. The average value of the low and high estimates was used to estimate the total BCA results and the low and high values were used in the uncertainty analysis to determine the impact on the overall results. The factors used to calculate the minimum and maximum number of stormwater that would be reduced by each GI measure (in gallons) were obtained from the Center of Neighborhood Technology (2010) and adjusted to the average annual rainfall in Chicago (Alon, et. al. 2014). The average number of gallons of stormwater that would be reduced for each type of GI measure and according to study area is provided in Table 25 and the average annual benefit for each GI measure according to study area is presented in Table 26.

Table 25: Average Number of Gallons of Reduced Stormwater Runoff

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Urban Agriculture	200,683	418,090	836,180	862,311	7,317
Bioretention	3,721,681	3,510,694	3,582,024	3,397,611	1,942,973
Rainwater Harvesting	4,409,205	4,164,160	5,925,920	2,497,215	1,601,600
Permeable Pavement	5,012,389	5,260,030	5,630,892	3,443,560	3,284,538
Downspout	133,972,608	75,053,265	93,378,868	118,668,978	38,993,070
Detention Basin	62,726,940	49,572,000	27,540,000	43,898,760	2,010,420

Table 26: Average Annual Benefit of Reduced Stormwater Runoff

Area 1	Area 2	Area 3 & 4	Area 5	Area 6
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Urban Agriculture	\$19	\$39	\$77	\$80	\$1
Bioretention	\$345	\$325	\$332	\$315	\$180
Rainwater Harvesting	\$408	\$386	\$549	\$231	\$148
Permeable Pavement	\$464	\$487	\$522	\$319	\$304
Downspout	\$12,411	\$6,953	\$8,650	\$10,993	\$3,612
Detention Basin	\$5,811	\$4,592	\$2,551	\$4,067	\$186
Planted Trees	\$5,988	\$6,179	\$5,208	\$4,300	\$2,855
Average Annual Benefit	\$25,446	\$18,961	\$17,889	\$20,305	\$7,287

Water Savings from water recovered/reused

Water conserved through rainwater harvesting can be used as greywater and offsets purchasing water from the City. The value of the water savings is monetized using the gallons of rainwater conserved and the cost of purchasing water. The City water rate of \$0.00381 per gallon (Chicago, 2015) remains constant for the BCA. Table 27 displays the average benefit of water savings per area.

Table 27: Average Annual Benefit of Water Savings

Area 1	Area 2	Area 3 & 4	Area 5	Area 6
\$16,799	\$15,865	\$22,578	\$9,514	\$6,102

Improved Air Quality

Trees can remove air pollutants, and store and sequester carbon dioxide. The air quality benefits for newly-planted trees were quantified separately from the other GI measures using the air quality value per acre of trees of \$239.39 established by FEMA (2013). The annual value by area is displayed in Table 28.

Table 28: Average Annual Air Quality Benefit from Trees

Area 1	Area 2	Area 3 & 4	Area 5	Area 6
\$980	\$905	\$790	\$829	\$528

The GI measures can sequester air pollutants, including greenhouse gas emissions (CO₂), ozone (O₃), nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (PM). The emission factors for each GI measure were obtained from Center of Neighborhood Technology (2010) and monetized using

emission values from the U.S. Department of Transportation (USDOT, 2015). The values were adjusted to 2015 dollar terms using the CPI-U (BLS, 2015c). The value for PM is \$167.45/pound, \$21.63/pound for SO_x, \$3.66/pound for NO_x, and \$3.42/pound for O₃. The average pounds of each criteria air pollutant sequestered annually and the monetized annual value is provided in Table 29.

Table 29: Average Annual Values for Criteria Air Pollutants

	Area 1		Area 2		Area 3 & 4		Area 5		Area 6		Total
	Lbs/ yr	Annual Value	Lbs/ yr	Annual Value	Lbs/ yr	Annual Value	Lbs/ yr	Annual Value	Lbs/ yr	Annual Value	Lbs/ yr
O ₃	9	\$32	20	\$67	39	\$135	41	\$139	0.3	\$1	110
NO _x	5	\$18	10	\$37	20	\$74	21	\$77	0.2	\$1	56
Sox	4	\$86	8	\$179	17	\$359	17	\$370	0.1	\$3	46
PM	2	\$259	3	\$540	6	\$1,081	7	\$1,115	0.1	\$9	18
Total	\$396		\$825		\$1,649		\$1,701		\$14		

Note: O₃ = ozone, NO_x = nitrogen oxides, SO_x = sulfur oxides, PM = particulate matter, lbs/yr = pounds per year

The greenhouse gas emission values are based on the Social Cost of Carbon (SCC) developed by the Federal Interagency Working Group on Social Cost of Carbon and suggested by USDOT (2015). The average reduction of CO₂ per year by study area is presented in Table 30. The value for CO₂ varies according to year.

Table 30: Average Annual Reduction of Carbon Dioxide (in pounds)

Area 1	Area 2	Area 3 & 4	Area 5	Area 6
1,556	3,242	6,484	6,687	57

The applicable social cost of carbon values in 2015 dollars and monetized values for each study area are presented in

Table 31.

Table 31: Social Cost of Carbon Values

Year	Value per Pound	Area 1	Area 2	Area 3 & 4	Area 5	Area 6	Total
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Year	Value per Pound	Area 1	Area 2	Area 3 & 4	Area 5	Area 6	Total
2023	\$0.026	\$40	\$83	\$166	\$171	\$1	\$461
2024	\$0.026	\$40	\$84	\$169	\$174	\$1	\$469
2025	\$0.026	\$41	\$86	\$172	\$177	\$2	\$477
2026	\$0.027	\$42	\$87	\$175	\$180	\$2	\$486
2027	\$0.028	\$43	\$90	\$181	\$186	\$2	\$503
2028	\$0.028	\$44	\$92	\$184	\$190	\$2	\$511
2029	\$0.029	\$45	\$93	\$187	\$193	\$2	\$519
2030	\$0.029	\$46	\$95	\$190	\$196	\$2	\$528
2031	\$0.029	\$46	\$95	\$190	\$196	\$2	\$528
2032	\$0.030	\$47	\$98	\$196	\$202	\$2	\$544
2033	\$0.031	\$48	\$99	\$199	\$205	\$2	\$553
2034	\$0.031	\$48	\$101	\$202	\$208	\$2	\$561
2035	\$0.032	\$49	\$102	\$205	\$211	\$2	\$570
2036	\$0.032	\$50	\$104	\$208	\$214	\$2	\$578
2037	\$0.033	\$51	\$107	\$214	\$221	\$2	\$595
2038	\$0.033	\$52	\$108	\$217	\$224	\$2	\$603
2039	\$0.034	\$53	\$110	\$220	\$227	\$2	\$611
2040	\$0.034	\$54	\$111	\$223	\$230	\$2	\$620
2041	\$0.035	\$55	\$114	\$229	\$236	\$2	\$637
2042	\$0.036	\$56	\$116	\$232	\$239	\$2	\$645
2043	\$0.036	\$56	\$118	\$235	\$242	\$2	\$653
2044	\$0.037	\$57	\$119	\$238	\$245	\$2	\$662
2045	\$0.037	\$58	\$121	\$241	\$249	\$2	\$670
2046	\$0.038	\$59	\$124	\$247	\$255	\$2	\$687
2047	\$0.039	\$60	\$125	\$250	\$258	\$2	\$695
2048	\$0.039	\$61	\$127	\$253	\$261	\$2	\$704
2049	\$0.039	\$61	\$128	\$256	\$264	\$2	\$712
2050	\$0.040	\$62	\$130	\$259	\$267	\$2	\$720
2051	\$0.041	\$64	\$133	\$265	\$273	\$2	\$737
2052	\$0.041	\$64	\$134	\$268	\$277	\$2	\$745
Average Annual Value		\$52	\$108	\$216	\$222	\$2	\$599

Reduced Nutrient Pollution

The included bioretention facilities would reduce nutrient pollution from excess nitrogen and phosphorus. The factors used to determine the number of pounds of nitrogen and phosphorus reduced was obtained from the Watershed Protection Techniques journal (Schueler, 1997). The monetized value per pound of the reduced nitrogen of \$3.71 (Shaik, et. al. 2002 and Birch, 2011) and phosphorus of \$38.88 (Ancev, et. al. 2006) come from multiple research journals. The annual estimated reductions and average annual values by study area are presented in Table 32.

Table 32: Average Annual Nutrient Pollution Reduction Benefits

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Average pounds of nitrogen reduced annually	5	5	5	5	3
Annual value of nitrogen reduction	\$18	\$19	\$19	\$18	\$12
Average pounds of phosphorus reduced annually	48	51	49	46	31
Annual value of phosphorus reduction	\$1,852	\$1,975	\$1,888	\$1,789	\$1,189
Total Annual Nutrient Pollution Reduction Benefit	\$1,870	\$1,995	\$1,906	\$1,807	\$1,201

Ecosystem and biodiversity effects from habitat creation

The ecosystem and biodiversity effects from creating new habitat were monetized using the FEMA value for pollination of \$307.75 per acre of green space. The ecosystem benefits are summarized in Table 33.

Table 33: Average Annual Ecosystem Benefits

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Habitat Created (acres)	7.2	8.5	7.7	7.1	3.8
Annual value of pollination	\$2,202	\$2,627	\$2,379	\$2,196	\$1,177

Reduced Urban Heat-Island Effect

The GI measures would make a small improvement in the urban heat-island effect. The reduced urban heat-island effect was monetized using the climate regulation values from FEMA of \$13.99 per acre of green open space of and \$419.30 per acre of trees (2013). The reduced urban heat-island effect benefits are summarized in Table 34.

Table 34: Reduced Urban Heat-Island Effect

	Area 1	Area 2	Area 3 & 4	Area 5	Area 6
Trees	\$51	\$55	\$68	\$57	\$23
Green Open Space (non-tree)	\$999	\$1,030	\$868	\$717	\$476
Total Annual Benefit	\$1,049	\$1,085	\$936	\$774	\$499

Reduced Energy Use

Newly planted trees provide shade to nearby buildings, thereby reducing costs for heating and cooling and saving energy. Natural gas and electricity savings were provided by the USDA Forest Service's i-Tree Tool (itreetools.org). This tool calculated the electricity benefit of \$7.07 per tree and natural gas benefit of \$29.78 per tree. The reduced energy use benefits are summarized in Table 35.

Table 35: Average Annual Reduced Energy Use Benefits

Area 1	Area 2	Area 3 & 4	Area 5	Area 6
\$38,177	\$39,393	\$33,202	\$27,416	\$18,204

D. Summary of Benefits or Costs that Are Difficult to Quantify

In addition to the quantified benefits, additional benefits are expected from flood resiliency efforts in the West Side Demonstration Area of Chicago. These are difficult to fully predict or to quantify accurately, although some elements may have known financial impacts.

1) Resiliency

Avoided emergency response costs: Costs are incurred by Federal, State, and local government agencies to provide emergency services during a flood and debris removal after a flood. FEMA defines critical public services for emergencies as fire stations, hospital emergency rooms, and police stations. Although the exact quantity of emergency response calls to be prevented by the proposed improvements could not be calculated, each response would be expected to cost \$440.43 (2015\$) for residences with basements and \$254.99 for those without.

Avoided displacement costs: Large floods may necessitate the evacuation of residences and the subsequent payment of government subsistence to residents who are required to seek alternative shelter. FEMA's Assistance to Individuals and Households Program (IHP) provides guidelines to determine the cost of displaced population after storms. The avoided cost would be based on the number of displaced households from the flood event (unable to be calculated), multiplied by the average daily room rate (\$194) plus the incremental cost of meals away from home (\$62.79), multiplied by the length of time of displacement (unable to be calculated).

Reduced property damages - property content: Reoccupation costs include costs to contract, supervise, and inspect repairs and to clean and disinfect homes. While the total costs related to future disasters could not be computed, it is known that during the 2013 flooding, the City documented that 6,320 individuals or households in the WSDA received FEMA assistance with a combined verified loss of \$3,483,124, or an average of \$547.

Avoided property damages – homeowner clean-up: Homes damaged by flooding often require clean-up by homeowners before residents can reoccupy. This can be quantified by the opportunity cost of time

multiplied by the number of hours spent on flood-related work per week. In serious cases, homes must be gutted, which costs nearly \$5,000.

2) Economic Revitalization

Construction and Engineering Jobs: During the construction phase the program's capital costs will permit approximately 600 workers a year (based on capital costs and using the IMPLAN sector code for maintenance and repair construction of non-residential structures to construct the green infrastructure and related solutions, and 370 engineering jobs per year (based on soft costs and using the IMPLAN sector code for architectural, engineering, and related services).

Workforce Development: *Some construction and maintenance will be conducted by trainees in the Greencorps Chicago program*, which serves an important social and economic benefit in an area of Chicago where the average unemployment rate is **18.5 percent**. ***The average per capita income in these communities is just under \$13,000.*** The typical Greencorps trainee is an African-American male within the age range of 24 to 35, has a record of incarceration, no high school diploma, and is currently unemployed. At least half are parents of children under the age of 18. The trainees are introduced to conventional expectations of the workplace and taught the technical skills of the landscaping trade.

Affordable Housing: The proposed program leverages private investment for affordable housing. This can be considered a benefit if residents are moving from market rate housing into affordable housing assuming that they are overspending on housing relative to their current incomes. In other words, the economic and social benefit is related to the housing stability between the market rent and affordable housing rent.

Increased property value other than through enhanced flood protection: Trees and green infrastructure improve "curb appeal," raising property values in Chicago at a rate of \$53.91 per tree annually. This is provided by the National Tree Benefit Calculator based on average Leaf Surface Area of 10" diameter Boxelder, American Elm, and Green Ash (three common Chicago species) for a single-family residential neighborhood. That value increases annually as the canopy increases.

3) Social

Improved health - Reduced diabetes cases/treatment expenditures: The project will increase access to public open space, which improves public health. The incidences of depression and anxiety, asthma and chronic obstructive pulmonary disease (COPD), diabetes, and coronary heart disease have been found to be significantly reduced for people living with more green space (10%, or more than the average) within a 0.6 mile radius, according to a study published by the Harvard School of Public Health. A 20 percent increase in greenery results in about 1.1% reduction of Type 2 Diabetes, for which the average annual cost of treatment is \$13,700.

Improved health - Reduced mental health cases/treatment expenditures: Dutch researchers have shown that residents with only 10 percent green space within 0.6 miles of the residence had a 25% greater risk of depression and a 30 percent greater risk of anxiety disorders in contrast to residents in the highest (90 percent) residential green space bracket. This is important because 36.2 million Americans pay an average of \$1,591 each year for mental health services, while the average expenditure per child was even greater, \$1,931.[2006 data, Source and escalate to 2015]. Therefore, even a 5% reduction in demand for mental health services leads to significant avoided costs.

Reduced Crime: According to several recent peer-reviewed studies, urban nature and green infrastructure is associated with reduced crime. Philadelphia's GI program has had an effect on safety in nearby areas. The models found significant reductions in certain crimes over an average four year follow-up period, indicating that a relatively long-term impact might be expected. In Baltimore, Troy et al (2012) found that a 10 percent increase in tree canopy was associated with a roughly 12 percent decrease in crime; the magnitude was 40 percent greater for public than for private-owned lands.

6. Risks to Ongoing Benefits

A. Key Risks

The primary risk to ongoing benefits is assuring the proper maintenance and operation of green infrastructure. This risk is minimized through the use of infrastructure the use of technologies that do not require frequent maintenance, by having trained maintenance staff nearby through the use of Greencorps trainee programs that hire locally and partnerships with established community organizations that help in monitor infrastructure condition. (See Attachments A & B).

This risk is also mitigated because the benefits achieved are distributed and incremental. A loss of runoff reduction due to failure of an individual piece of infrastructure would not negate the benefits of other pieces of infrastructure so built.

B. Uncertainty Analysis

The other risk is to the accuracy of the benefit estimates. The NPV and BCR findings were tested using uncertainty analysis, which evaluated the full range of minimum and maximum values possible to assess their effect on the final outcome values. The uncertainty analysis was performed using Monte Carlo simulations in the @Risk software, distributed by Palisade Corporation.

The minimum and maximum values identified in the benefits section were estimated using uniform distributions. A uniform distribution is composed of a minimum and maximum value. This distribution assumes that there is an equal likelihood of any value within the range occurring.

The appropriate probability distributions for each variable were incorporated into the BCA model. A simulation, consisting of 10,000 iterations, yielded probability distributions defining the likelihood of any single outcome occurring. The simulation produced a distribution of the possible NPV and BCR results.

AECOM performed a sensitivity analysis of the BCA to determine the certainty of the benefits. While the analysis is still under evaluation, preliminary findings indicate that benefits exceed costs even when the BCA uses the most conservative assumptions. The sensitivity analysis will be more completely explained in the final submission to HUD.

7. Assessment of Implementation Challenges

A. Potential Risks to Schedule and Mitigation of Risks

Stakeholder risks involve assurance of the intended level participation in measures on private property, such as downspout disconnections. To mitigate this risk the organizational structure involves community-based delegate agencies as partners to encourage such participation, and the Department of Water Management has experience using community leaders and event entertainers to bring resident attention to the downspout disconnection program. The application also sets feasible goals for participation by individuals.

Political risks are not anticipated as the proposal has support from elected officials, municipal elections are not scheduled until 2019, and the City's interest in green infrastructure has held true for multiple administrations.

The primary technical risk is assuring feasible siting for the proposed green infrastructure improvements during project engineering and implementation. However, this is mitigated by the availability of alternative locations within the WSDA; a list of potential improvements and locations was prepared during proposal development, then reduced to the modeled scenario to assure cost-efficiency and achievability. Thus, the remainder of the list serves as a "deep bench" of effective substitutes if a location or technology in the modeled scenario is later found infeasible.

The primary procedural risk is delay in the contracting of contractor and professional services. However, as demonstrated in the capacity section and the Phase I application, the City's Department of Procurement Services has experience managing the contracting of large-scale infrastructure projects, and due to the visible and sensitive nature of these projects, will prioritize them as necessary to assure they are bid and contracted as expeditiously as legally possible.

B. Community Support

The City has broad support for the proposal as witnessed by the breadth and depth of the partner agencies, both regional and community-based, in the development of this proposal. One of the partners is the Little Village Environmental Justice Organization which serves as an advocate for a predominantly Latino community (Area 6), but also is a coalition member of the nation-wide Climate Justice Alliance and The Environmental Justice Leadership Forum on Climate Change. Another is the Center for Neighborhood Technology, an award-winning nonprofit research and advocacy organization whose mission includes “improving urban economies and environments ...through ...testing and promoting economically efficient and environmentally sound solutions; and demonstrating the value of investing in sustainable solutions.”

Following the Phase I application City staff began met with stakeholders at 45 community organizations between May and September 2015 to identify priority areas of need. This culminated in five public meetings conducted throughout the WSDA in September. In a charrette format, residents and community leaders identified specific locations where flooding impacts were worst, and where solutions might most appropriately be located. *Details of these meetings are provided in Attachment D.*

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